

POPULAR SCIENCE

May 1946 • 23c



***Are Secret Balloons
the Flying Saucers?***

PAGE 98

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VOL. 152: NO. 5

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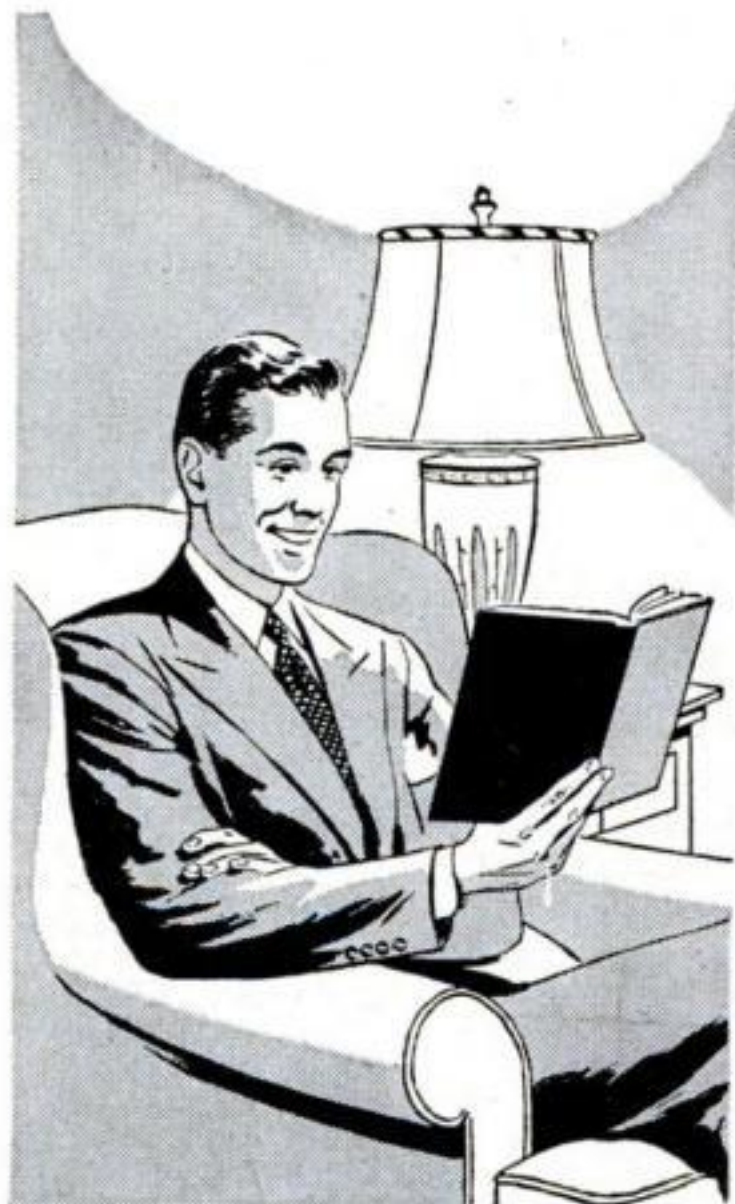
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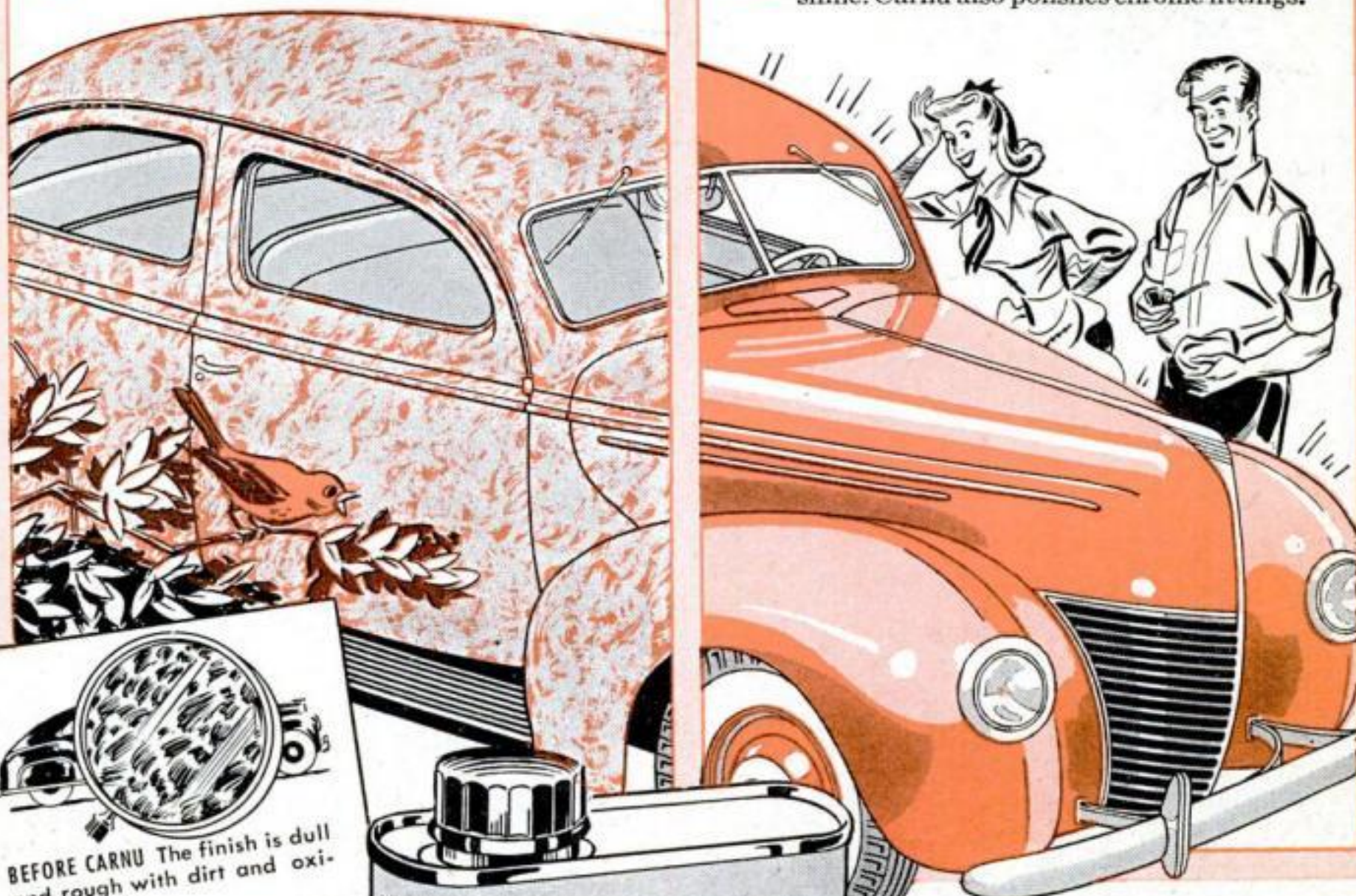
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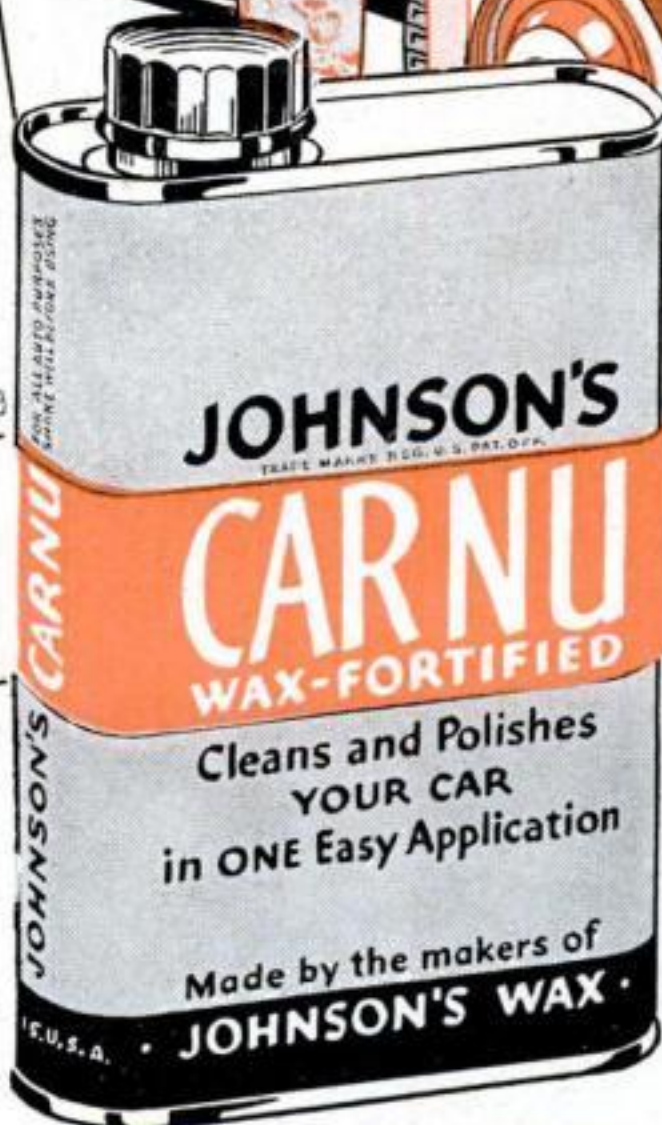


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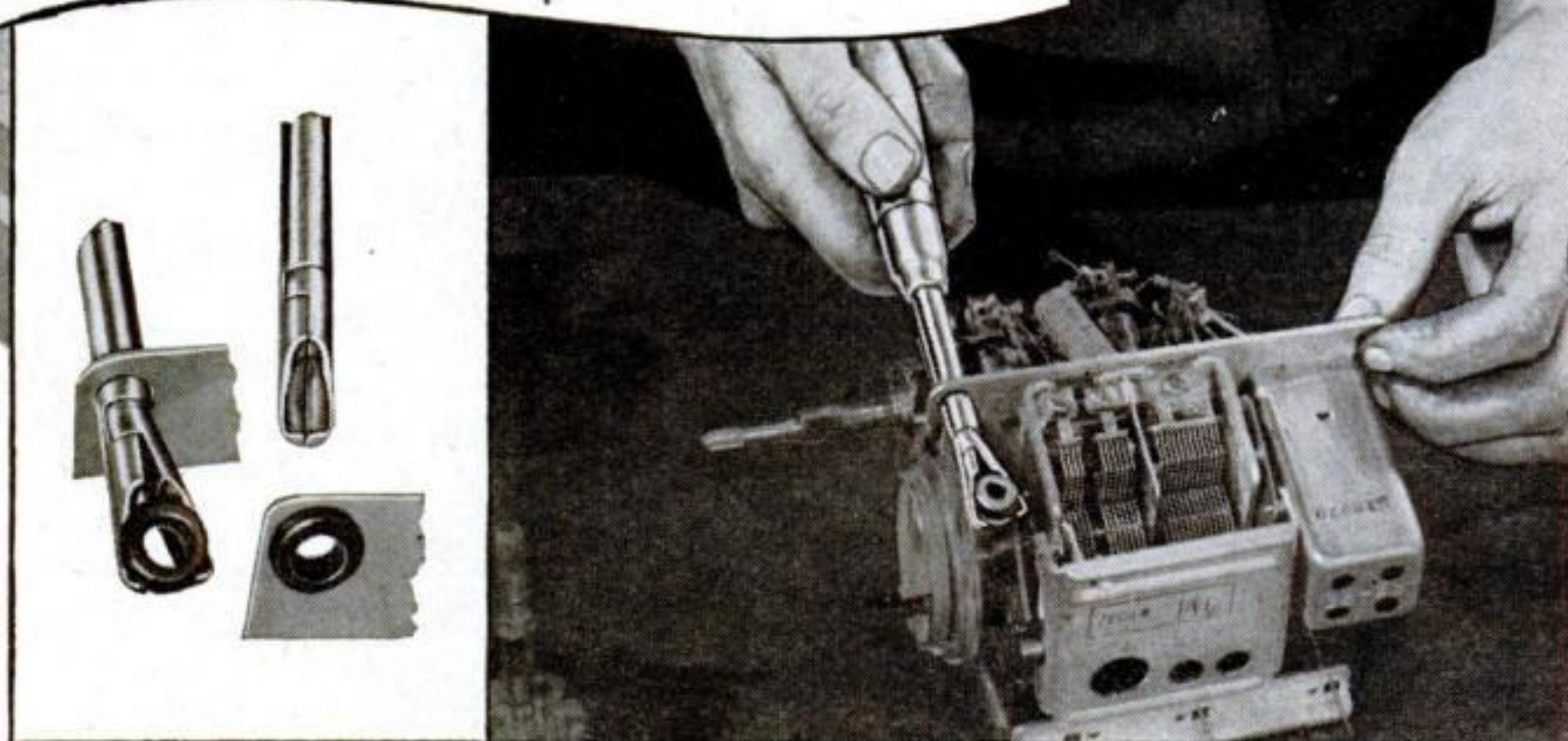


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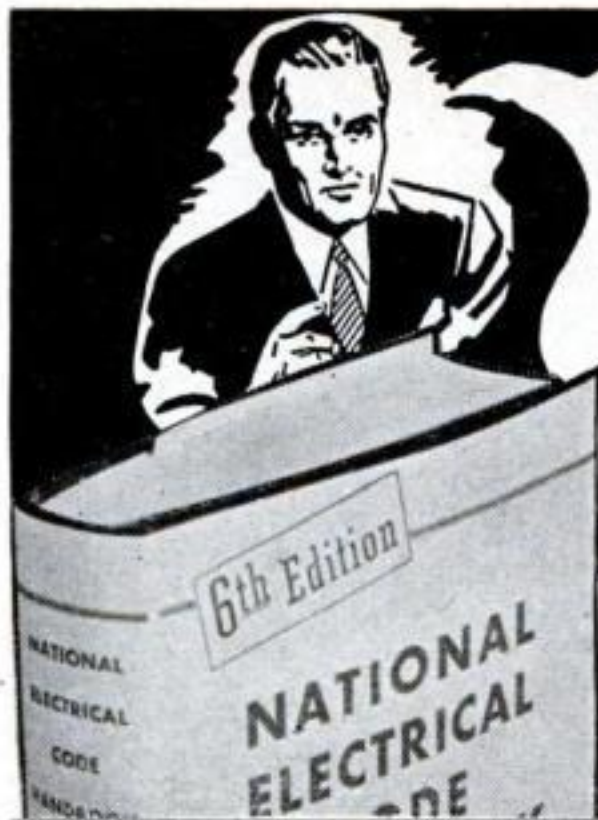
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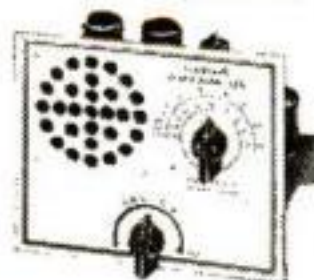
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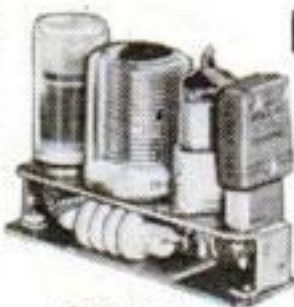
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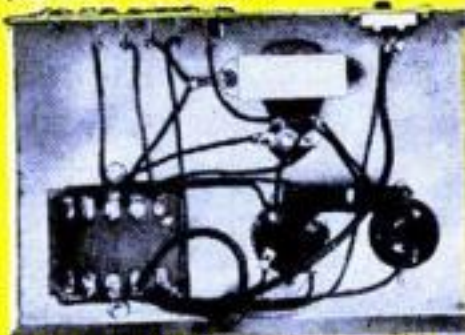
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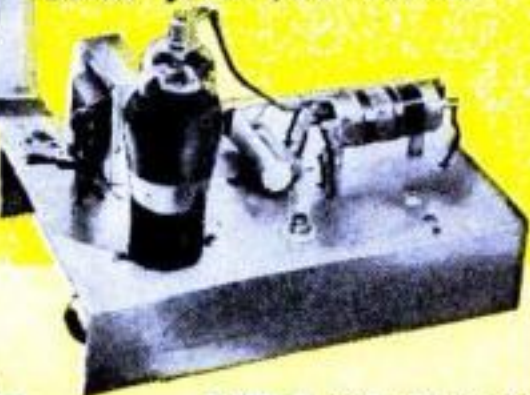
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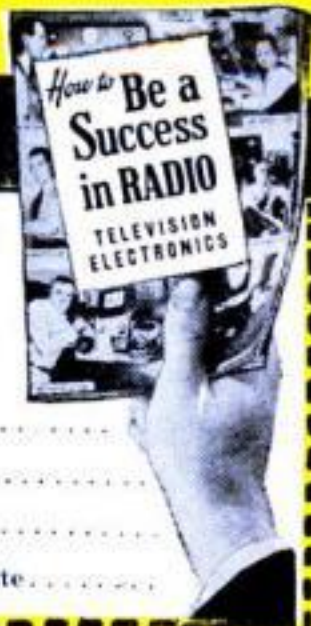
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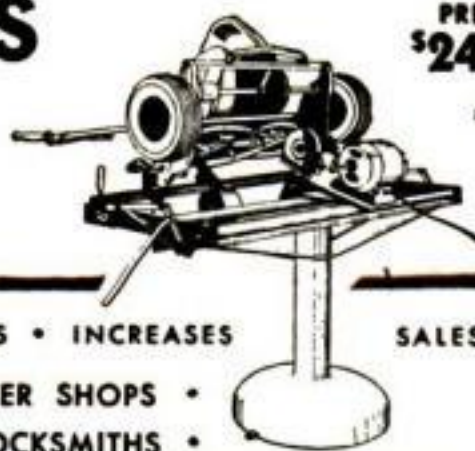
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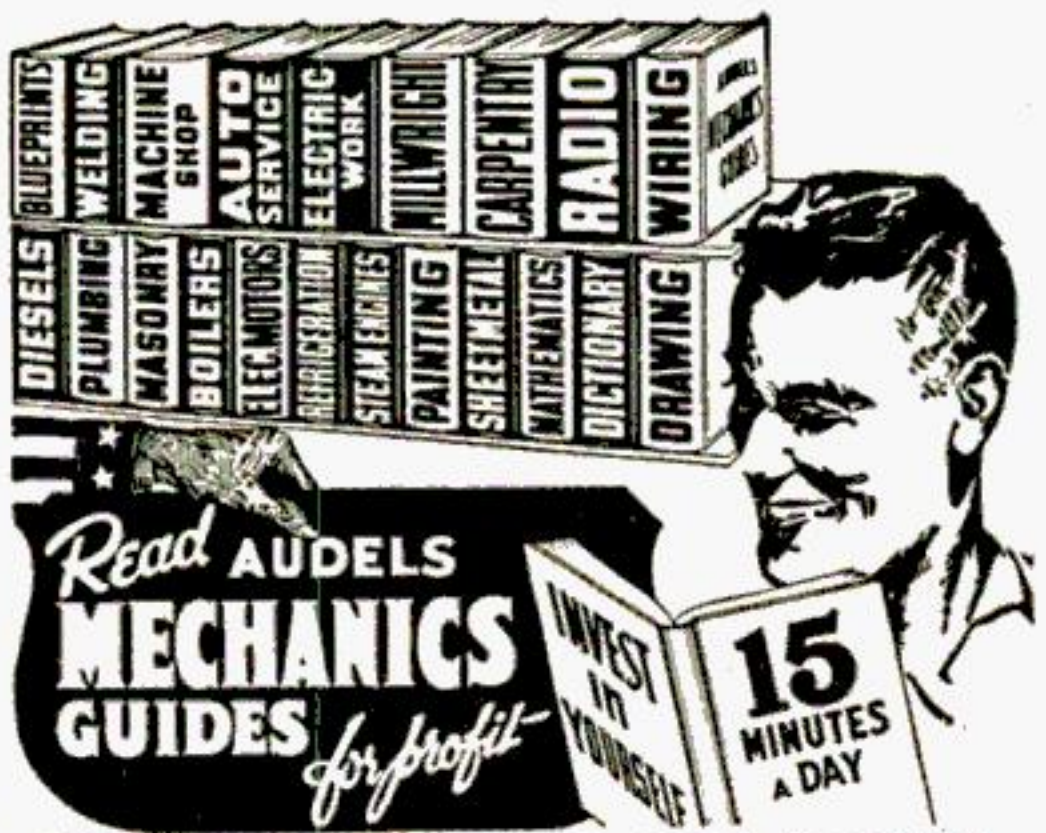
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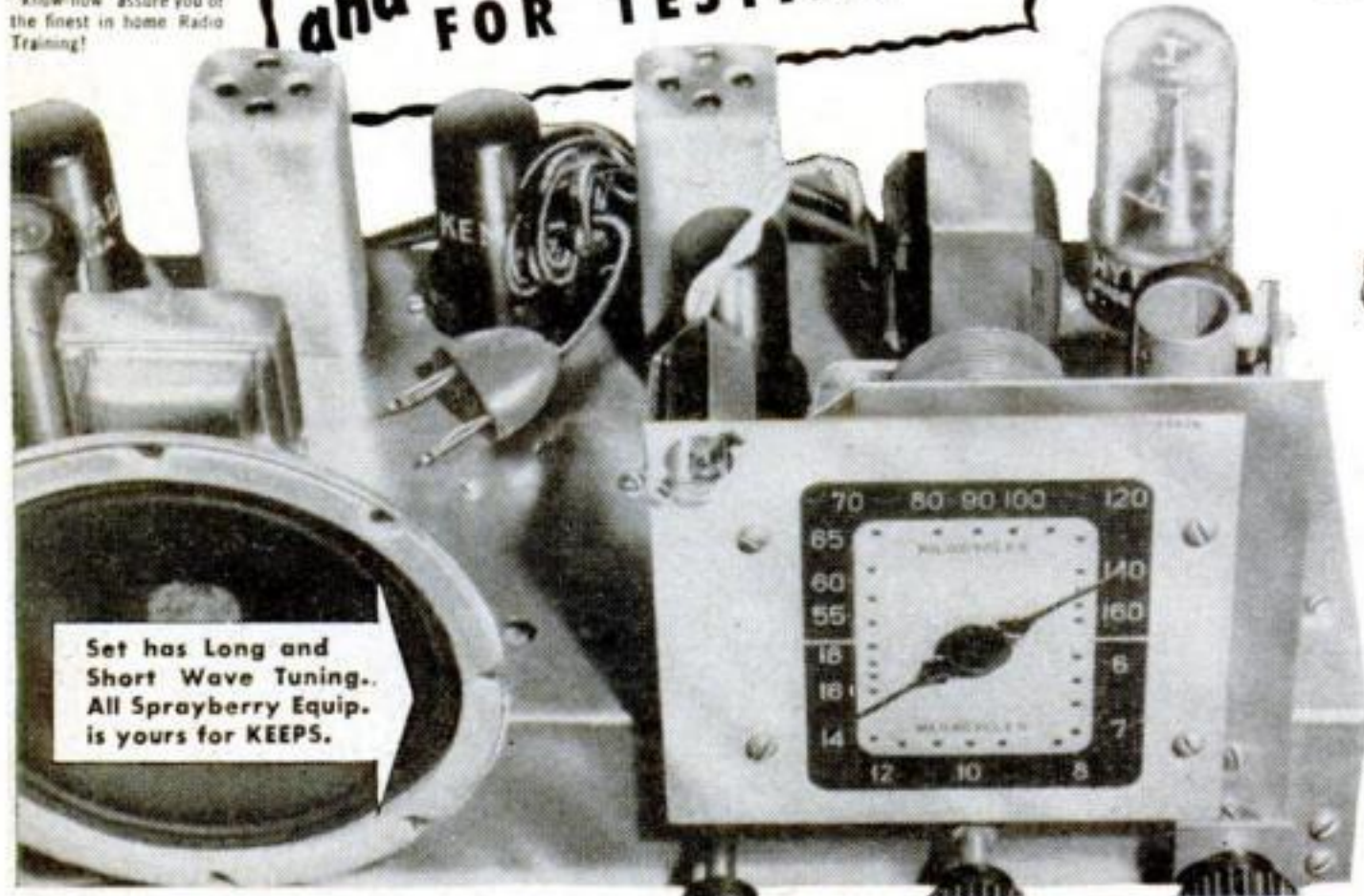
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A patent gives the inventor the exclusive right to prevent others from making, using, or selling the invention claimed in the patent for a period of seventeen years.

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Letters

Experts Approve

Sir:

Some time ago you were kind enough to grant us permission to reprint a feature from POPULAR SCIENCE, "Sandhogs' Toughest Job," in *The Laborer* [Official Publication of the International Hod Carriers', Building and Common Laborers' Union of America].

Please be assured that we deeply appreciate your courtesy in letting us use the excellent story.

J. M. RAGSDALE

Ransdell Inc.

Washington, D. C.

Tucker Talk

Sir:

We have just read your very interesting article on page 302 of your current [February] issue, captioned "Plain Talk About the Tucker."

Frankly, we cannot understand the basic reason for publishing this article since it obviously has only one purpose—to discredit the Tucker and the Tucker organization in general. In order that we may have some plain talk with you, as the head of Popular Science Monthly Magazine, our company is one of twelve hundred reputable dealers in the Tucker family. Down here in Texas, we speak straight from the shoulder and your so-called "editorial" comment on the Tucker is certainly not appreciated in this section of the country at least, and we are sure that there are several other million people who cannot appreciate the position you have taken in this matter through your comparison of the Buick Dynaflo with the Tucker's method of power transmission. Up to this point, we were under the impression that your magazine was definitely nonpartisan in bringing your readers information about automotive improvements. Undoubtedly, you have inadvertently lost a lot of reader respect through publishing this article concerning the Tucker automobile.

Perhaps, if you would send down one of your new reporters with a modern viewpoint, we feel that he could undoubtedly get the information he needs to satisfactorily pre-

INVENTORS

patent laws encourage the development of inventions

The Rules of Practice of the U. S. Patent Office advise—unless an inventor is familiar with such matters—that he employ a competent registered attorney or registered agent, as the value of patents depends largely upon the skillful preparation of the specifications and claims.

The firm of McMorrow, Berman and Davidson is registered to practice before the U. S. Patent Office. Additionally, it maintains a staff of attorneys able to readily understand inventors' disclosures, to advise concerning patentability, and to prepare appropriate specifications and claims for filing with the Patent Office.

If an inventor believes he has an invention, a search of the most pertinent prior U. S. patents should be made and a report obtained relative to its patentability. Where such report indicates that the invention appears patentable, in order to secure protection, diligence should be exercised in making application for a patent.

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sent the Tucker in the manner in which it should be presented. It is only natural that the Tucker Automobile has a lot of men in the automotive industry worried and we are proud to be a part of this organization even though the part we play is very unimportant.

JAMES F. PIGG

Service Sales Co., Inc.
Dallas, Tex.

Sir:

Congratulations on your editorial "Plain Talk About the Tucker" in the February issue. You are right in not publishing press agents' claims as facts.

I am a collector of automotive literature and have been a student of automobile design for 20 years. . . . I have written letters to Tucker without getting a single fact about the car in return. . . . If the car will run, why not say how it runs?

I like your policy and I hope you continue it.

WILFRED R. FRANSON

Eugene, Ore.

PS will be glad to report on the Tucker when we can drive it, as we did Buick's Dynaflo.

Wrong-Way Stretch

Sir:

I think Mr. Fiske [What's your I.Q.—PS, Dec. '47, p. 185] was stretching his imagination as well as his shelf. If he received any money for his suggestion, he had better run right out and buy a new shelf, as this one is at least four inches too short.

E. P. SLUGG

Willow Grove, Pa.

Mr. Fiske stretched his shelf, all right, but the cartoonist stretched the imagination by showing the middle of the shelf longer after being cut than before. Actually, it remains the same, but, being wedge-shaped, pushes out the two ends, making a longer shelf with a narrower middle. Try it yourself with a cardboard cutout.

First Scientist—Aak?

Sir:

We were quite startled when we opened the February issue of PS and found ourselves looking at your editorial and the illustration of the bearded gentleman moving

ADVICE

for the INVENTOR

The United States Patent Office advises the inventor, unless he is familiar with such matters, to employ a competent registered patent attorney or agent as the value of patents depends largely upon the skillful preparation of the specification and claims.

PRELIMINARY STEPS *toward* PATENT PROTECTION

The Evidence of Invention form mentioned below is offered as a convenience to the inventor in making his disclosure of invention.

The inventor should date and sign his disclosure and have it witnessed by two or more persons who are capable of understanding his invention. The disclosure should then be mailed to the registered patent attorney or agent whom he selects to assist him. The dis-

closure should be accompanied by a letter authorizing the patent attorney or agent to conduct a preliminary search in the Patent Office among previously granted U. S. patents for similar types of invention. The patent attorney or agent then prepares a report of the probable patentability of the invention and recommends the further course the inventor should take, provided the report indicates possible patentability.

Victor J. Evans & Co. . . . has a staff of experienced, registered patent attorneys available to assist inventors in the preparation and prosecution of their cases before the Patent Office. The coupon below is suggested as a convenience to the inventor in starting action on his invention.

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the rock. We still don't know whether to credit telepathy or coincidence with an assist.

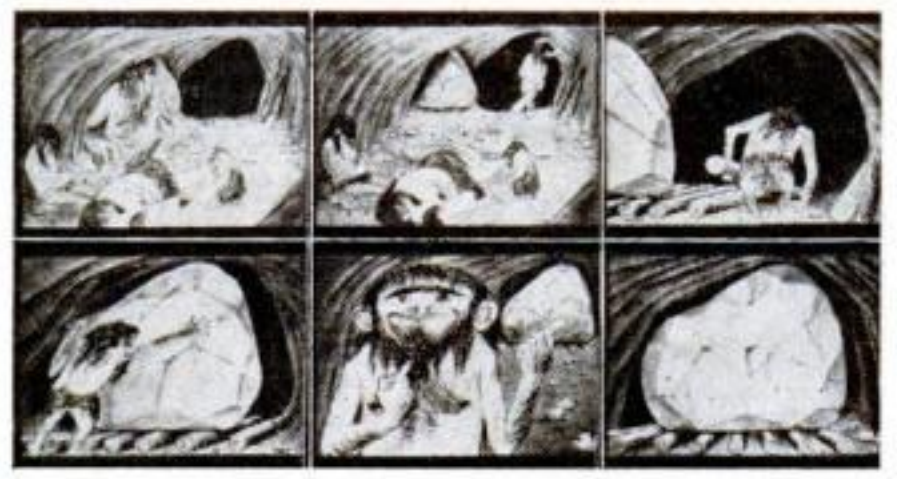
I have used this illustration many times in talks on conveying systems as a possible beginning of the art of mechanical handling,



and late this year we came out with a slide film for college use in which we used the cave man as our illustration. Your man is handsomer, I must admit, than Aak, our hero.

I think you will be amused at the parallel so am inclosing a close-up of Aak [above] and the first few frames of the film [below].

R. C. SOLLENBERGER
Conveyor Equipment Manufacturers Assn.
Washington, D. C.



Since we were both trying to begin at the beginning, it was only logical that we should both start with "A" for "Aak."

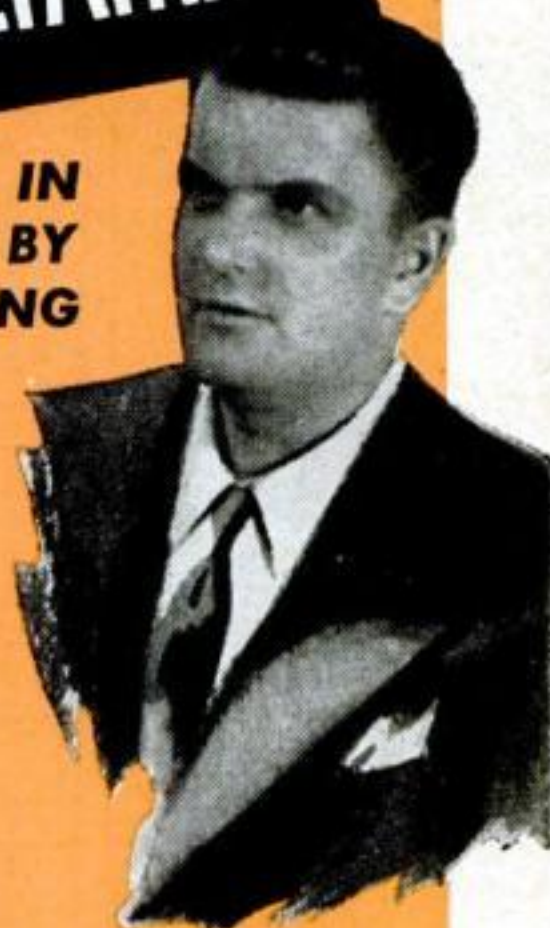
Why Doesn't Henry Spin?

Sir:
On page 140 of your February issue, a picture appears with the heading "Ramjets Hoist Little Henry." As far as I can see, it appears to have only one prop. Pray tell me why the body itself does not spin around? I always thought a helicopter had to have

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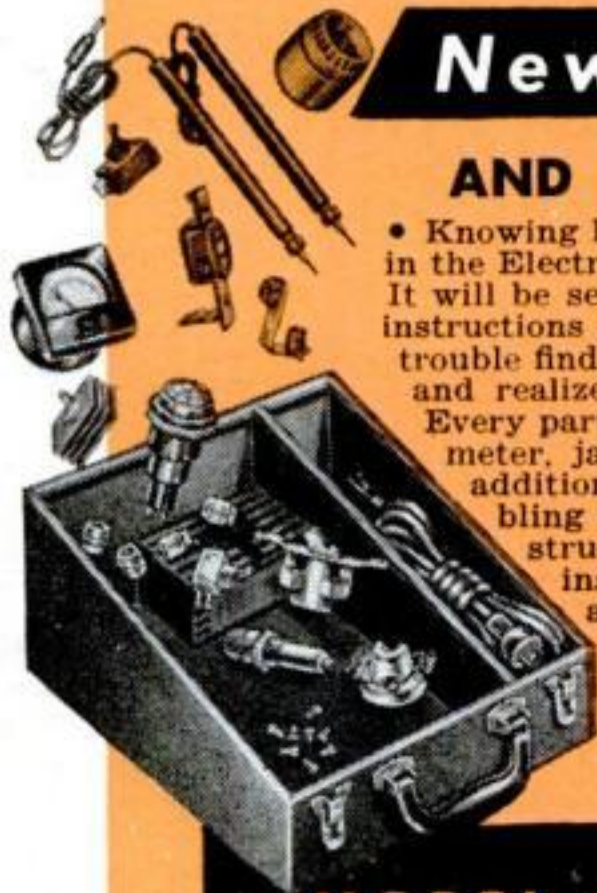


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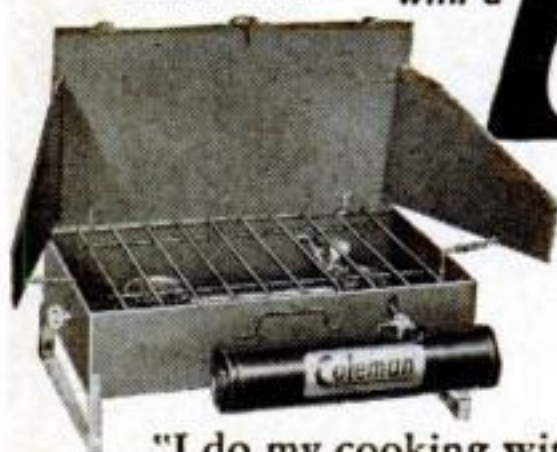
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Roxbury, Conn.

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Wild, Hell, or Bearcats?

Sir:

While reading the February issue of POPULAR SCIENCE, I came across an article on page 124, and some of the information seems to be wrong. The planes on the flight deck are not FM-2 Wildcats but F6F Hellcats.

I was stationed on a naval air base operating FM-2s and aboard a carrier operating F6Fs, as shown on the carrier's deck.

CHARLES H. MAYER

To help unscramble its "cats," PS decided to call on the Navy—which comes up with still another one:

Sir:

The plane pictured on page 124 of the February PS is an F8F Grumman Bearcat. There is no other plane having a four-bladed propeller, straight wings, and the bubble located in such a way. Five specialists in the Aviation Section all agree.

COMDR. WILLIAM J. LEDERER, U.S.N.
Office of Public Relations
Department of the Navy
Washington, D. C.

Professor PS on the Platform

Sir:

I plan to make a short speech illustrating the material covered in your article on the Buick Dynaflo drive [Feb. '48, p. 113] in my seminar class at the New York University College of Engineering.

I would appreciate it immensely if you could supply me with diagrams similar to those in the article but magnified approximately five times. . . .

JOSEPH MARCUS
Port Chester, N. Y.

PS is happy to help N.Y.U. and is sending Mr. Marcus enlargements of the diagrams.

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*Charles
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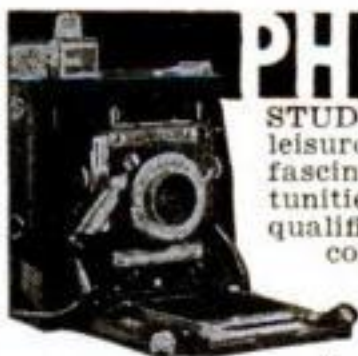
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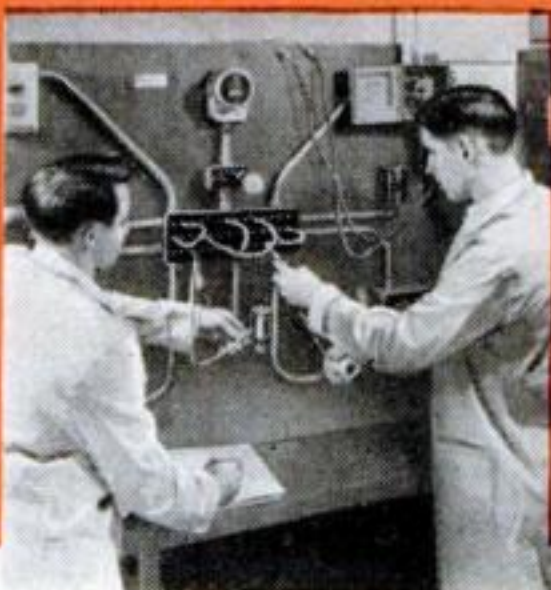
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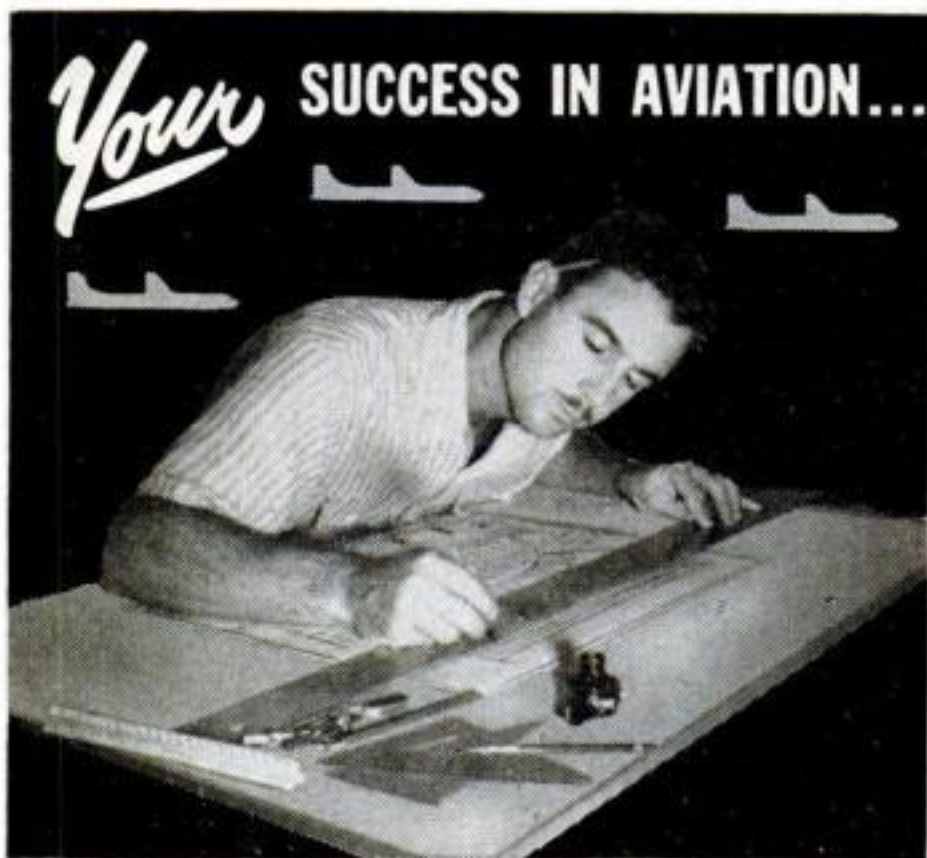
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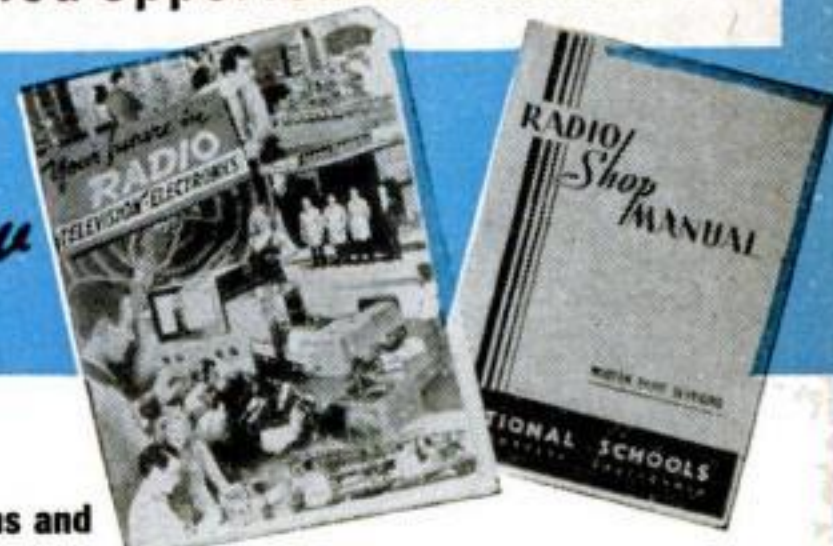


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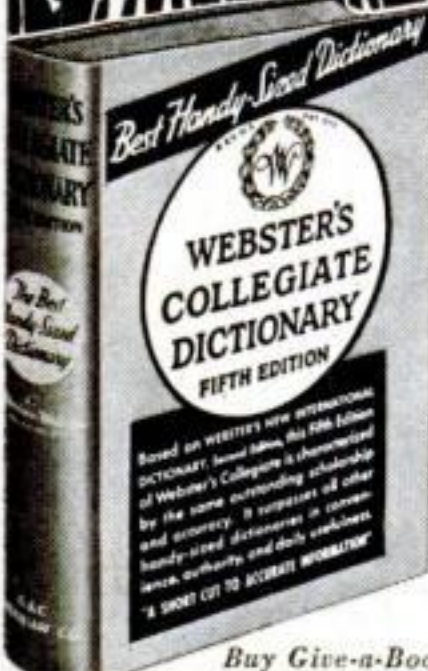
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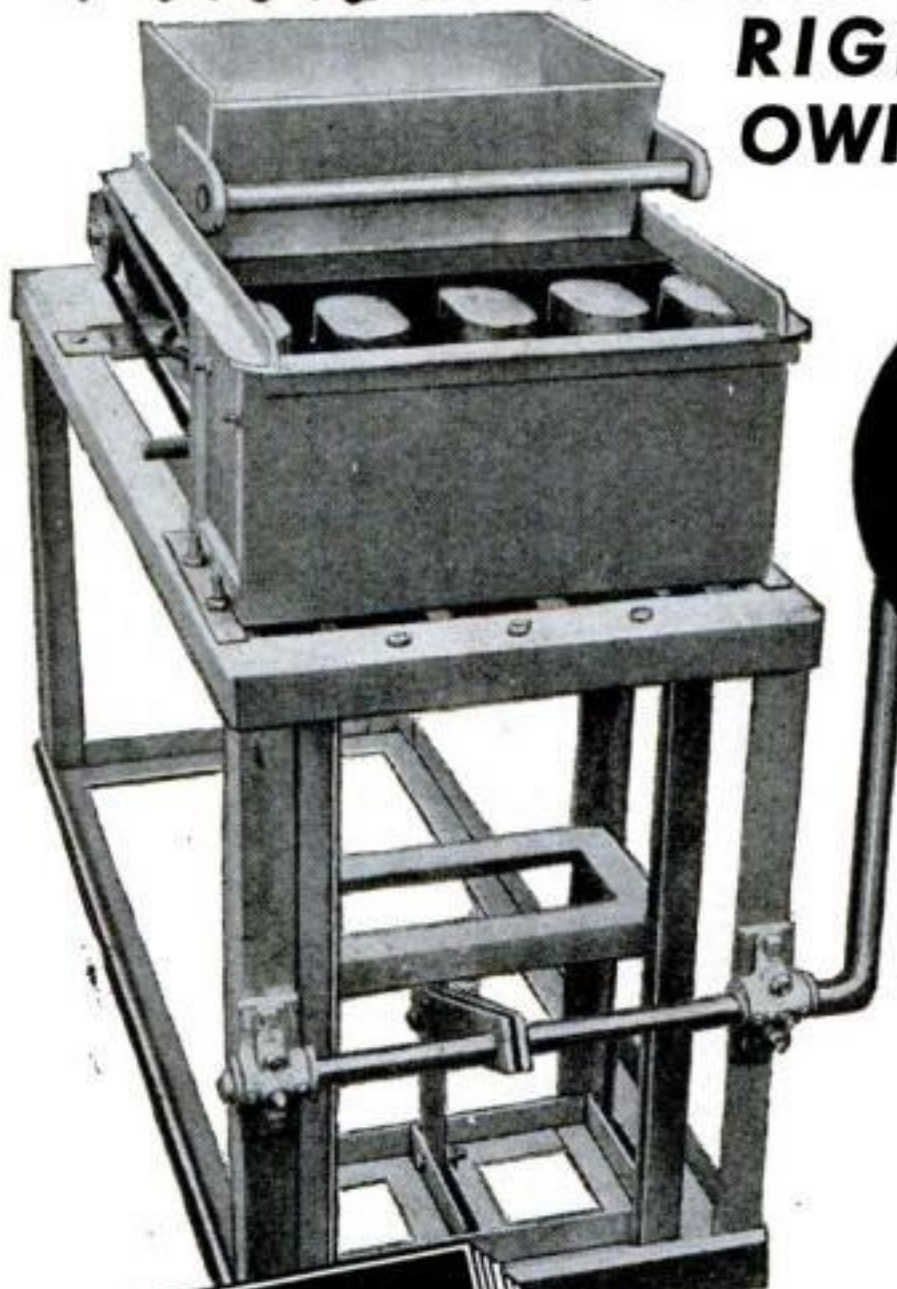
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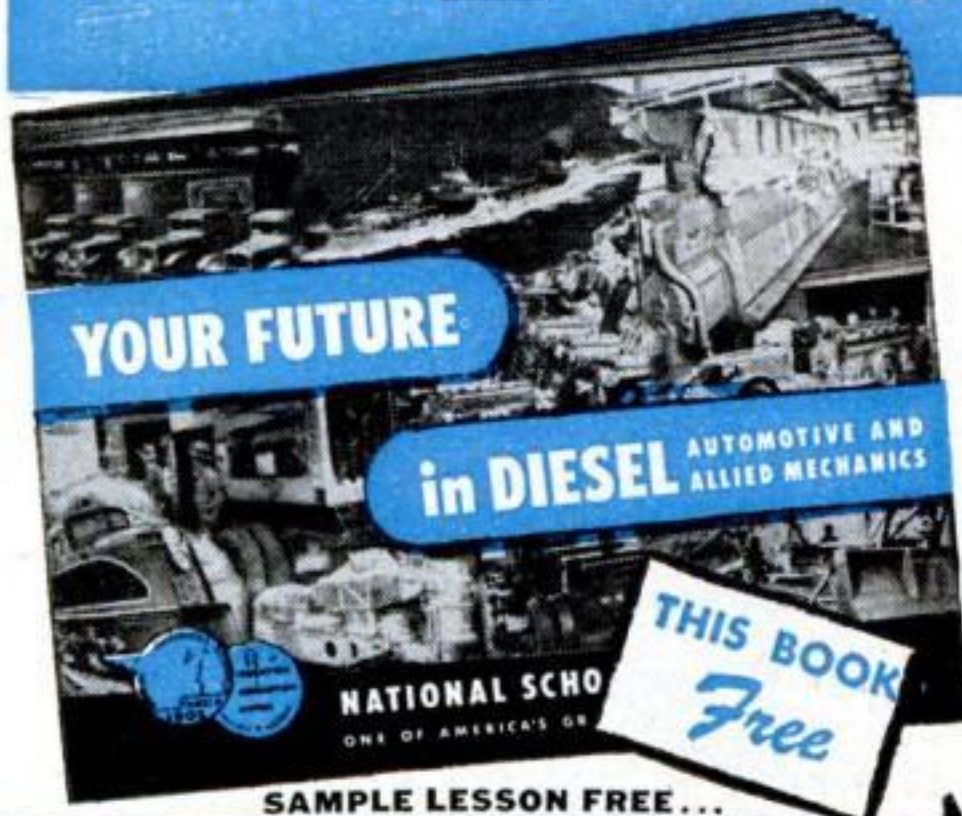
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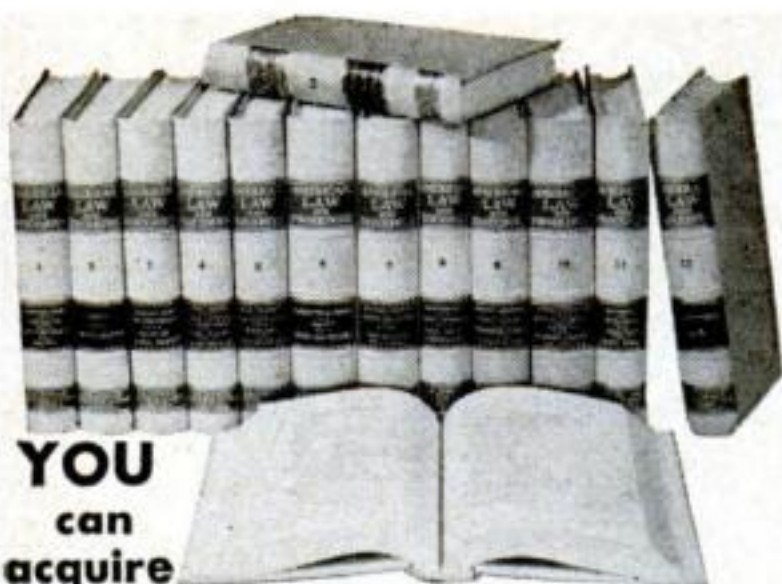
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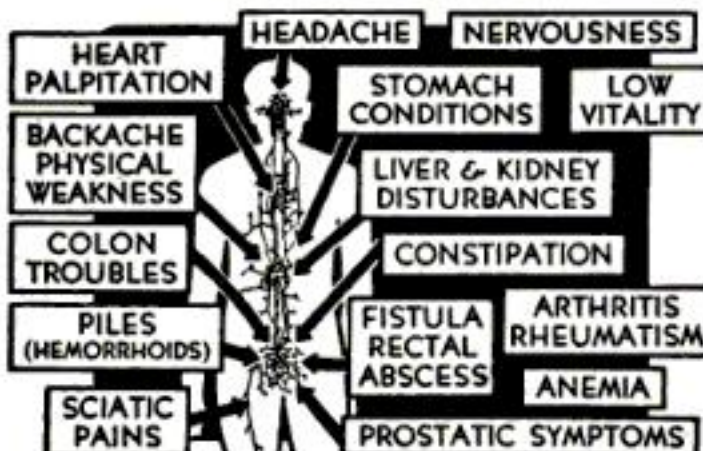
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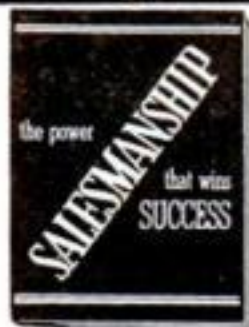
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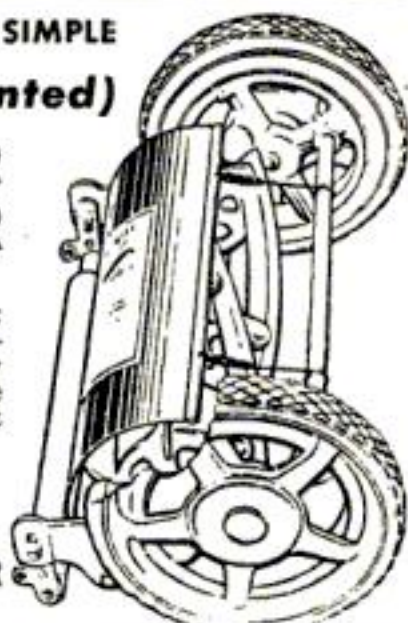
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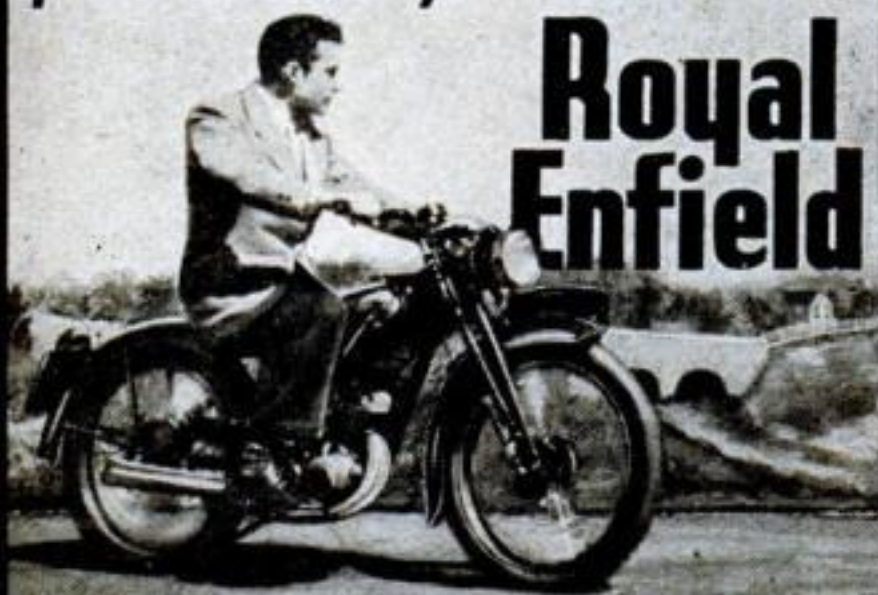
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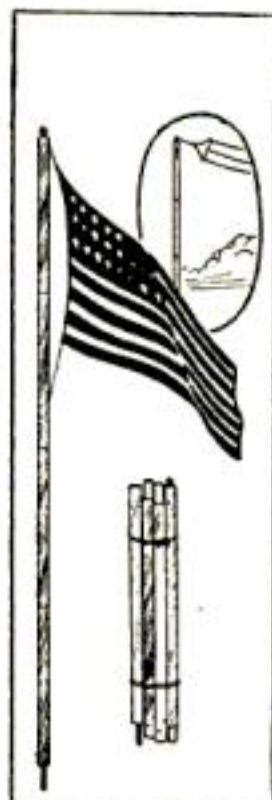
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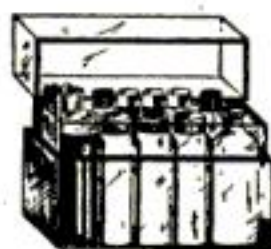
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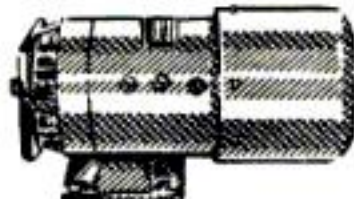


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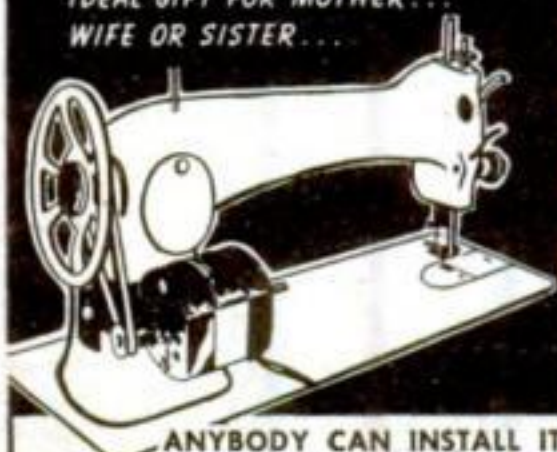


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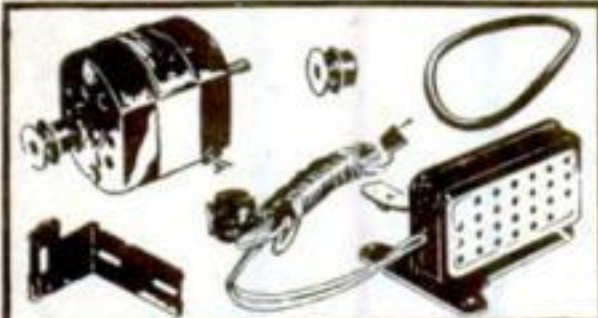


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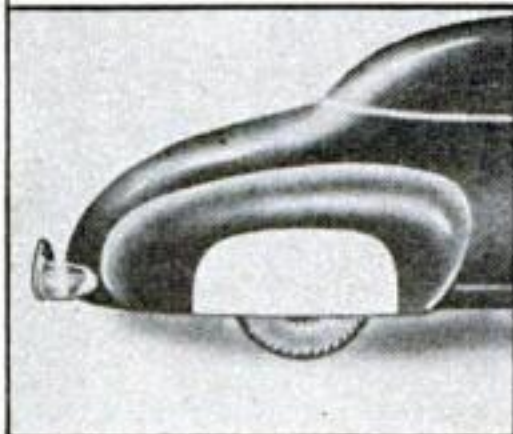
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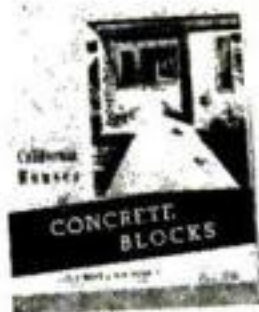
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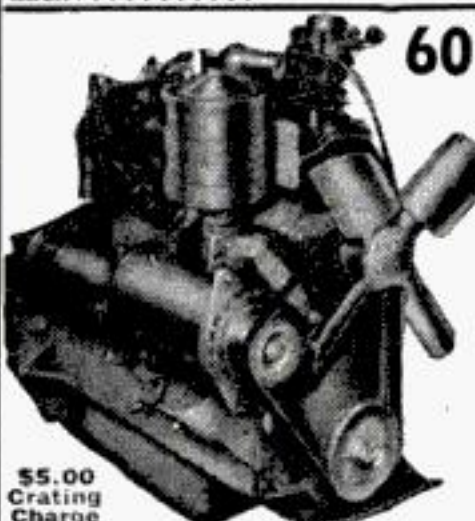


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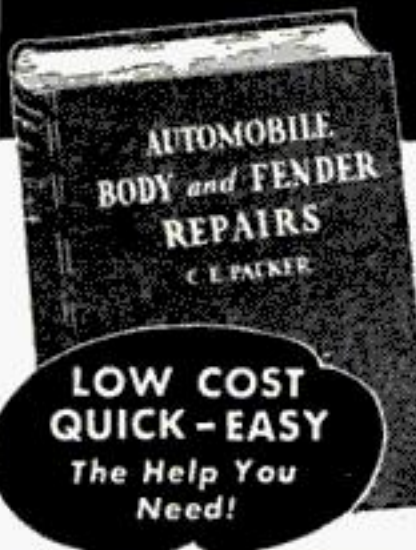
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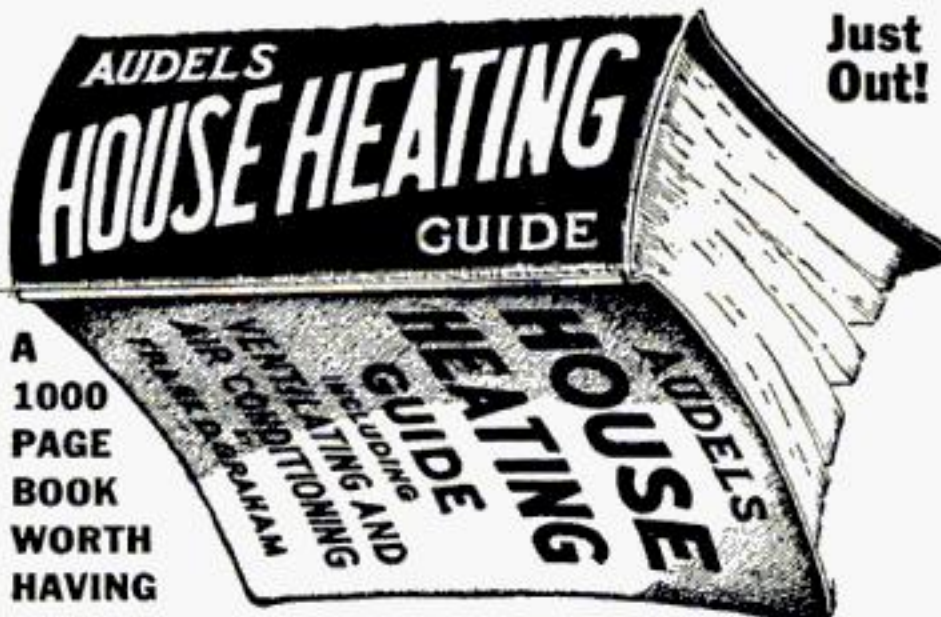
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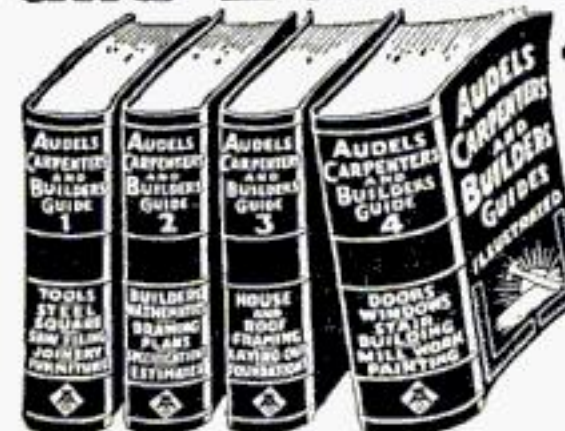
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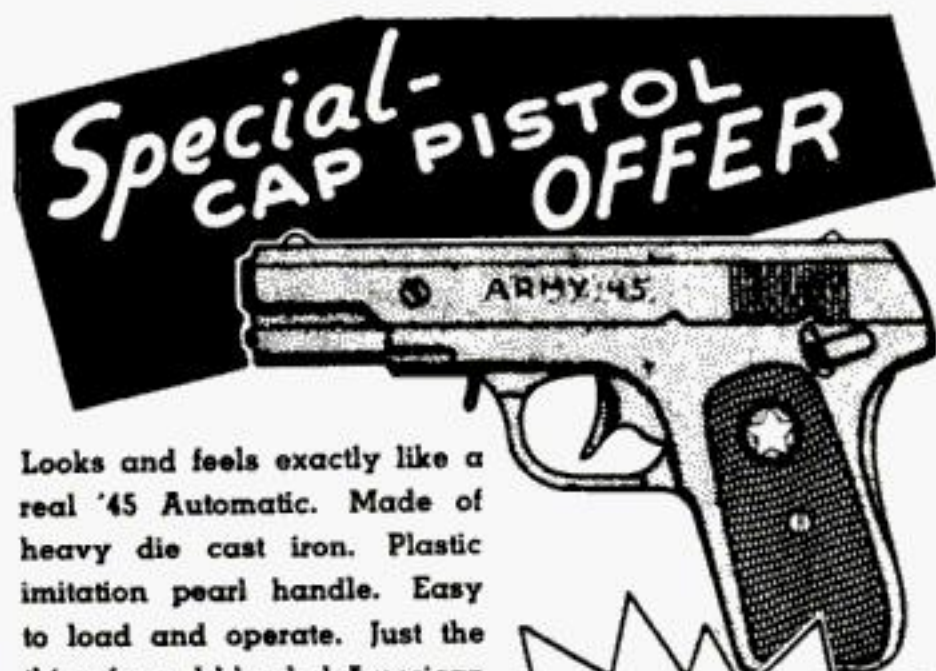
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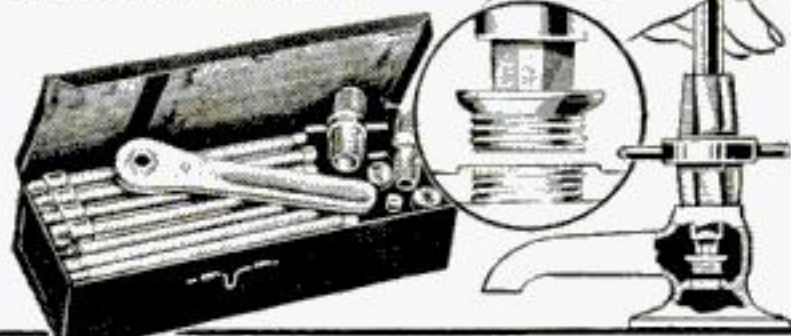
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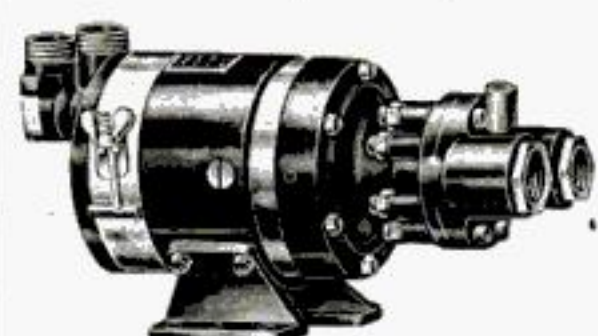


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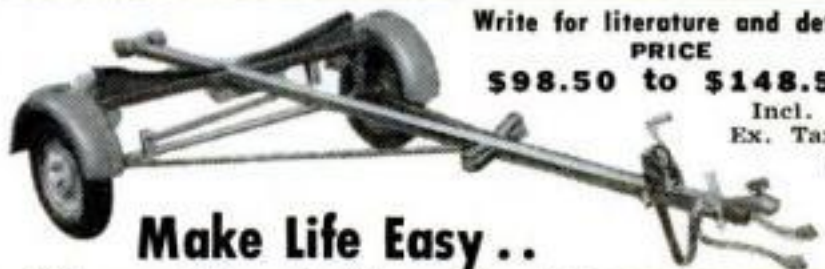
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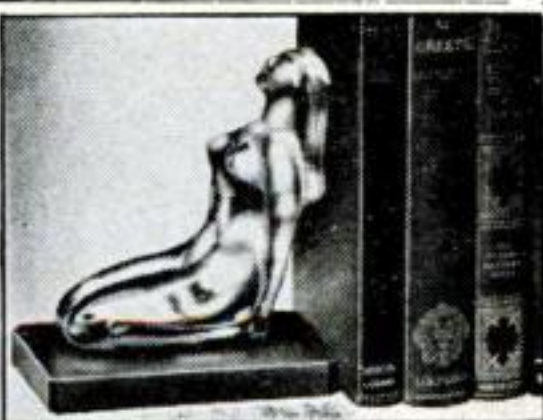
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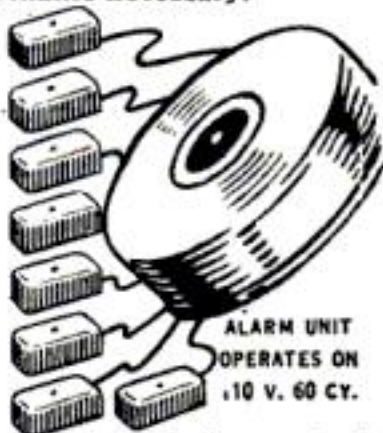


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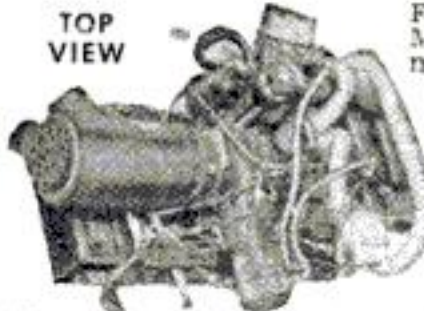


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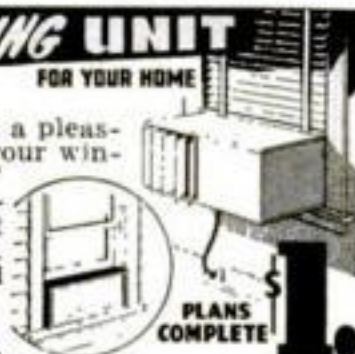
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AT Home—Your own manufacturing business; making popular \$1.00 novelties. Cost you 3c to 15c. Everything supplied. Write So-Lo Works, Dept. D-601, Loveland, Ohio.

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GENUINE Natural Latex for rubber molds. Only two coats necessary for thick mold. Make money reproducing statuary, plaques, novelties. Low cost. Write Major Chemical Company, 131 Inman Street, Cambridge, Mass.

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SUDSY inexpensive fluffy bead detergent. Formula, one dollar. Satisfaction Guaranteed. J. Dick, Box 5641, Indianapolis.

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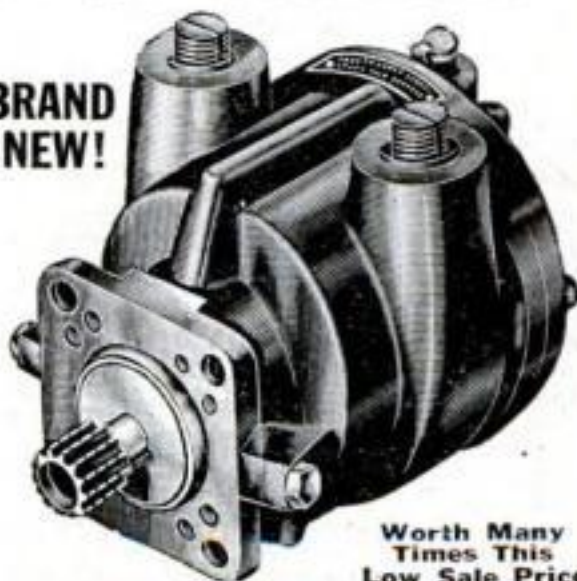
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You're right in the game—with Television

Comes the shout "Play Ball!" and there you are—on top of every play.

Through television developments in RCA Laboratories, all the action is yours—the crack of bat against ball—every step of fast infield plays—even sidelights in bull pen, dugout, grandstand and bleachers.

At the ball park, RCA Image Orthicon television cameras—

rivalling the human eye in sensitivity of "vision"—get all the action in day or night games. Shifts from over-all views of the field, to "close-ups," are swift and revealing . . .

And at the *receiving end*—your RCA Victor "Eye Witness" home television set gives you brighter, clearer pictures. You can see the ball that the batter misses, or you can watch his home-run sail over the fence.

Today, because of the original and continuing work of RCA scientists, millions can enjoy sports, entertainment, educational and news events, on television. Research at RCA Laboratories—always a "step ahead"—enters every instrument marked RCA or RCA Victor.

When in Radio City, New York, be sure to see the radio, television and electronic wonders at RCA Exhibition Hall, 36 West 49th Street. Free admission. Radio Corporation of America, RCA Building, Radio City, N.Y. 20.



RADIO CORPORATION of AMERICA



This Shipping Clerk Is Scientific

THE man with the funny-looking yardstick is Melvin Brockman, cargo specialist with United Airlines. The yardstick is the "cube stick" he invented to speed up measurement of the cubic content of packages, on which rates are based. This mathematical yardstick is scaled in logarithms.

Maybe you don't know what logarithms are or how they work. You can find out about these tools of mathematics in any public library. The point is that you don't need to know any more about them than the shipping clerk who is taking down the readings. Like so many scientific tools, they can be used without being completely understood.

Sure, it doesn't take a genius to multiply nice even dimensions to get cubic content.

But if the measurements of a box are 38" by 42" by 47", you will probably need pencil and paper. You will have to perform twelve individual multiplication operations and nine additions.

Using the logarithmic cube stick, with four-place figures, you need perform only five operations in addition. Even if you have to struggle with the primitive mathematics of a bank statement, you know it is easier to *add* three five-figure numbers than to *multiply* three two-figure numbers.

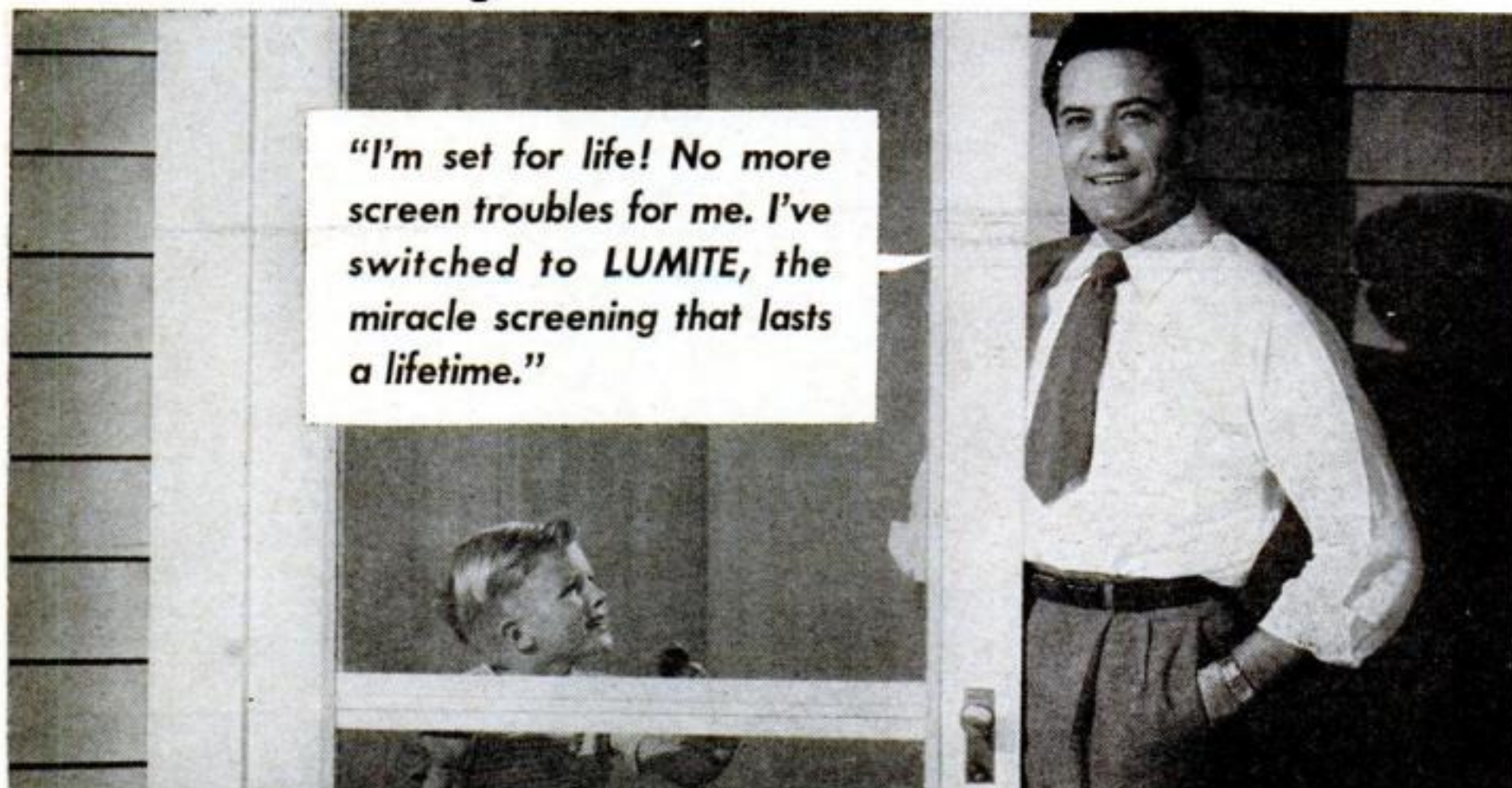
United Air Lines expects this cube stick to catch "tens of thousands of dollars of lost revenue"—a big saving from a little scientific gadget.

Perry Withers

MAY 1948 95

NOT IN 100 YEARS

Will this screening ever rust, corrode or stain your house !



This spring get this amazing new screening that's sweeping the country

Incredible, but true, LUMITE screening will NEVER rust, NEVER corrode, NEVER stain your house! Laboratory tests . . . and actual use in homes throughout the country have proved that LUMITE will not change in any weather or climate!

Woven of saran's tough, resilient plastic fibres, LUMITE is virtually indestructible. It never needs painting . . . always stays

taut and firm . . . protects the beauty of your house. This amazing new kind of screen is in stock today at your Hardware, Lumber, or Building Supply Dealer. If you need screens for any part of your house this spring, be sure to order your supply of LUMITE now!

***®** For further information and free sample write Dept. 43, Lumite Division Chicopee Manufacturing Corporation 47 Worth Street, New York 13, N. Y.



Rustproof!

Stainproof!



Never needs painting!

Lasts a lifetime!



Screen once and for all with

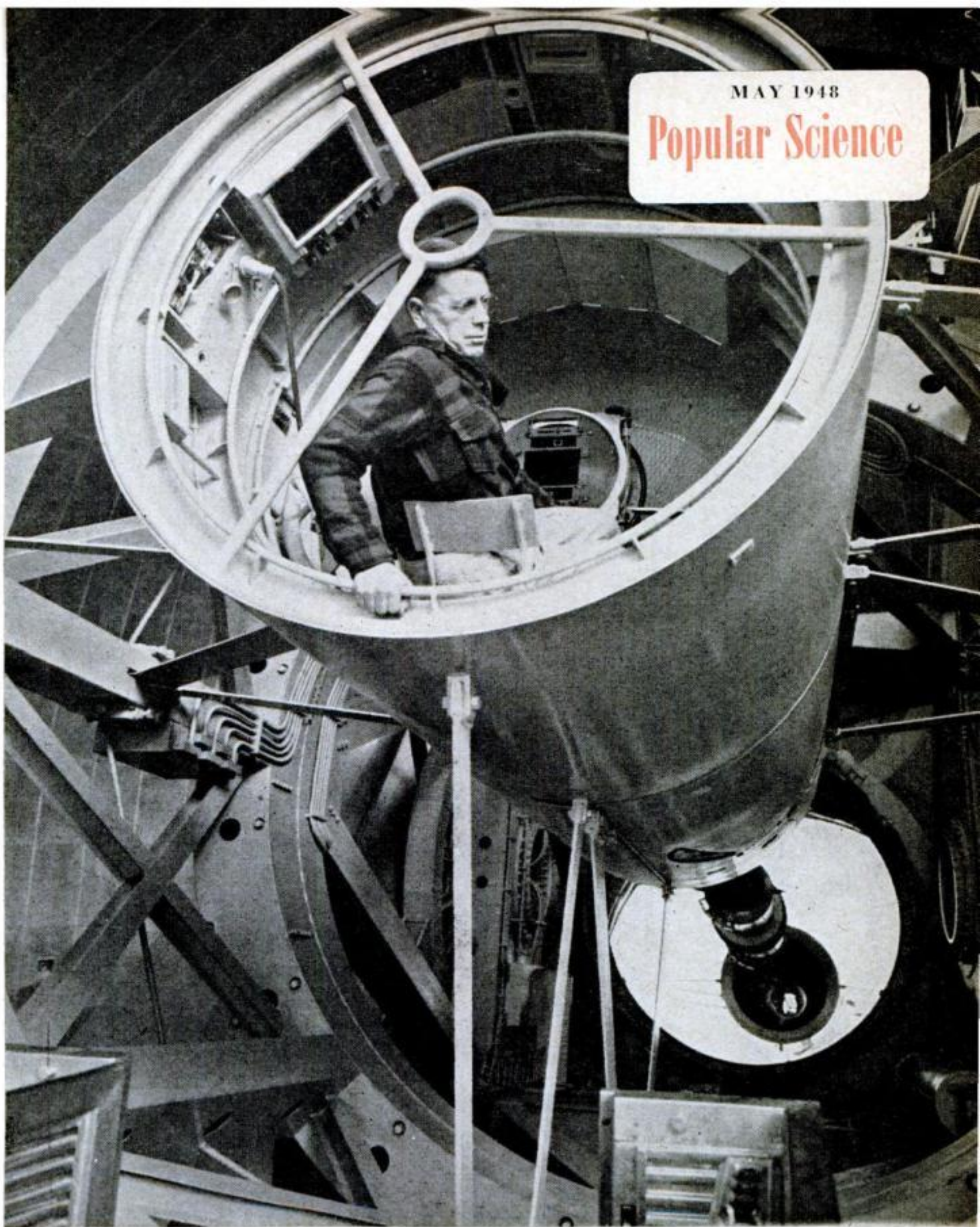
LUMITE*

Woven of saran




MAY 1948

Popular Science



Outward Bound... From this six-foot-diameter observer's cage, hanging in mid-air at the most starward point of Palomar's giant telescope, modern stargazers will soon be probing the mysteries of outer space a billion light years away. Far below, the 200-inch, 15-ton mirror turns its shimmering face skyward, snugly in place after years of preparation. It will reflect its collected starlight up through a small hole in the cage bottom. From this "prime focus," observers will direct the sighting of the big spyglass by telephoning operators below. Then they will slip a photographic plate in place, and the whole telescope will become a gigantic camera tracking across space.

MAY 1948 97



Unmanned research balloon soars upward, dangling its 70-lb. payload of weather instruments on line from open ring at bottom. Here, soon after launching, gas fills only tip of bag. As it rises, gas expands until at 100,000 feet it fills the entire balloon.

Are Secret Balloons the

The saucers could be sun reflections on low clouds, or they could be flattened hailstones, gliding down toward the earth.

Then the saucers could be Army weather radio-sonde balloons, fitted with radar reflectors.

An Australian teacher showed his students that with prolonged gazing red corpuscles passed in front of the retina of the eye. As a result they "saw" objects in the sky.

One sure-fire flying saucer that fell to the earth in New Mexico turned out to be a weather balloon. Another, near New York, was just a cluster of balloons carrying cosmic ray equipment.

Twenty miles above the earth, the U. S. Navy
is hanging its laboratories in space.
Balloons that swell to 77 times their starting
size provide the floating platforms.



New Balloons Explore Roof of the Airways

By Devon Francis

LITTLE FALLS, Minn.—In the brilliant Minnesota sky floats a pin point of light. To the unpracticed eye, it is only a meaningless white speck against the midday firmament. But to a cluster of men tracking its course by radio direction finder, radar, and theodolite, it represents the culmination of half a century of effort to throw light on some of this planet's darkest mysteries.

Such pin points, think the men who track them, may be the innocent source of the "flying saucer" stories. Actually, the one we are watching is an unmanned balloon, 100,-

000 feet above the earth. Never before has anything but a rocket gone that high. When the balloon was launched a little more than an hour ago, its helium content made a semi-transparent bubble only 17 feet in diameter. Now, almost 20 miles above us, it has expanded to a great 100-foot-tall envelope measuring 70 feet in diameter.

Expansion did that. At 100,000 feet the air is only 1/100 as dense as it is at sea level. The helium is pushing, seeking release, despite a temperature so low that if a man were exposed to it he would die within a minute. Though the sun is at its zenith, the balloon floats in darkness under a can-

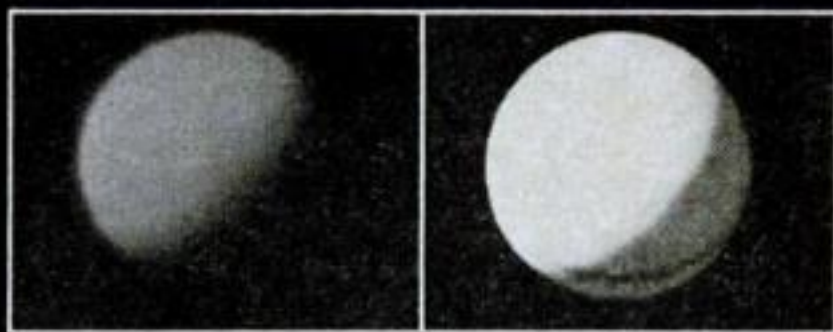
Flying Saucers?

One educational authority suggested that seeing flying saucers was merely a case of the "meteorological jitters."

Another, that they *were* meteors.

Still another explanation: speeding airplanes churn up the atmosphere and cause distortion of light rays. The resulting phenomena could be electrical in nature, causing something like smoke rings in the sky.

A not implausible explanation was based on the high reflective qualities of glass. Why couldn't the saucers be sunlight reflected by plane windows?

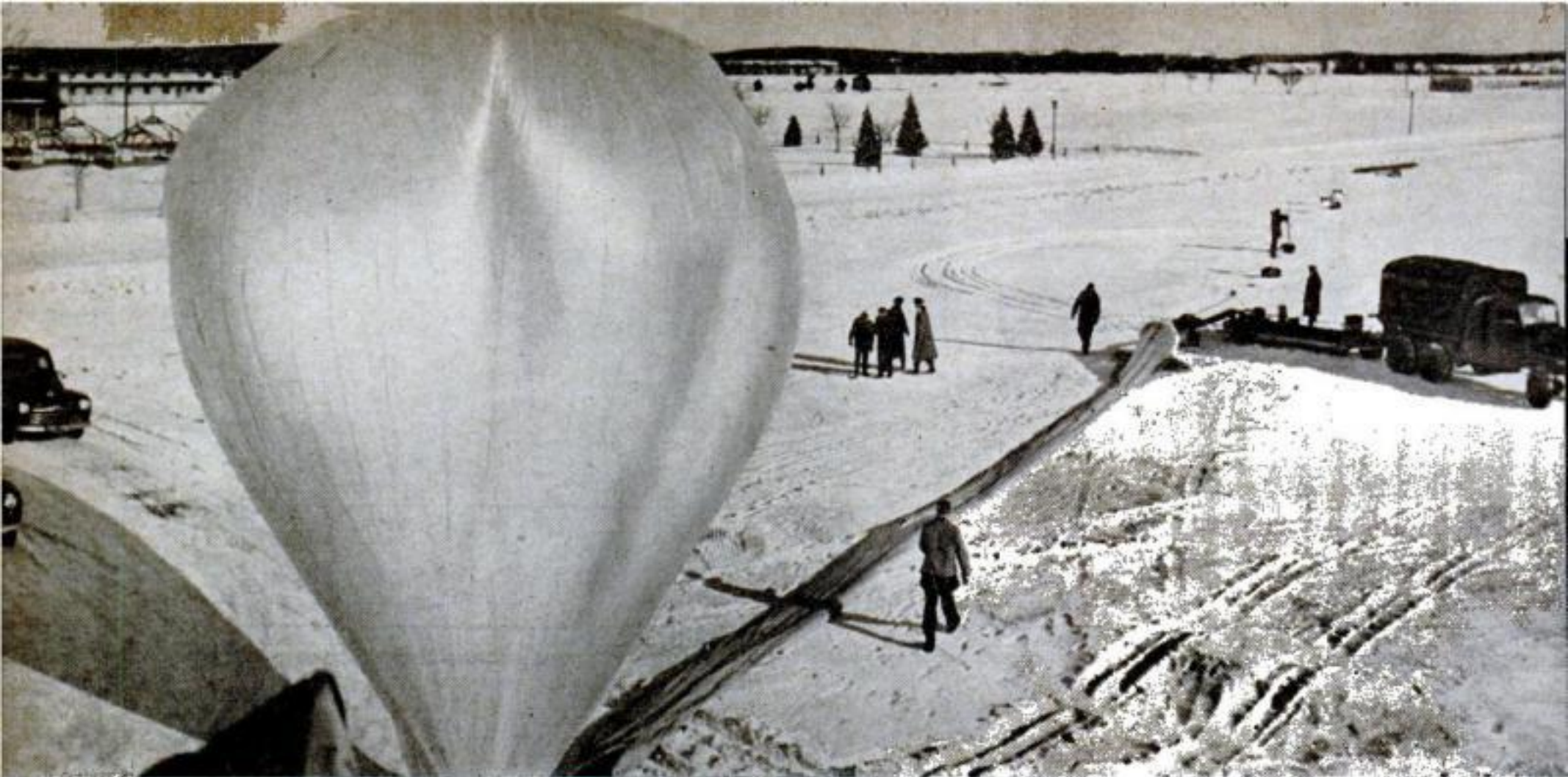


At left above is a pretty convincing picture of a flying saucer.

It was created by Popular Science photographers in their own studio. By altering lighting on table-tennis ball at right, above, they simulated natural light on high-altitude balloon for effect at left.

And that's how your eyes can deceive you. Your guess is as good as the next.

MAY 1948 99



Helium is piped through thin, extruded-plastic tube to form 17-foot bubble. Tapelike line

stretching toward truck is rest of balloon envelope. Helium-bottle dolly is at rear of truck.

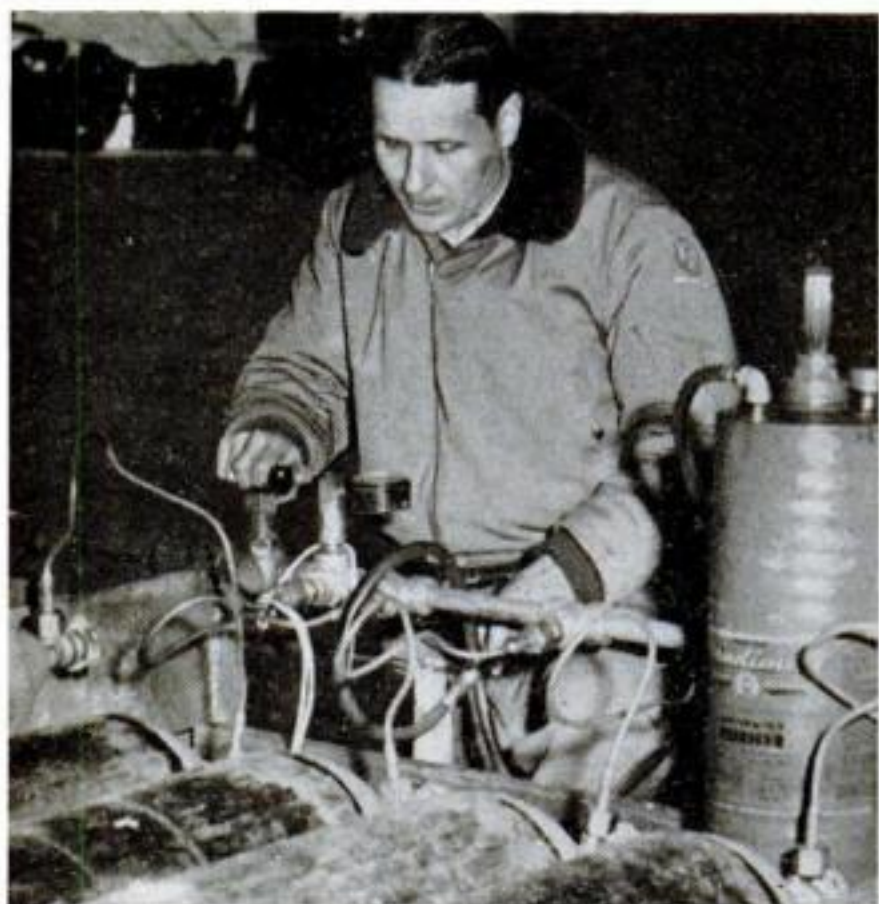
opy of stars, for the darkness at its altitude is eternal.

From a harness at its open end dangles a long load line, and to the line are attached a limp parachute and a string of instruments. These instruments are all-important—the balloon is only the vehicle used to deliver them to the altitude that scientists want to explore.

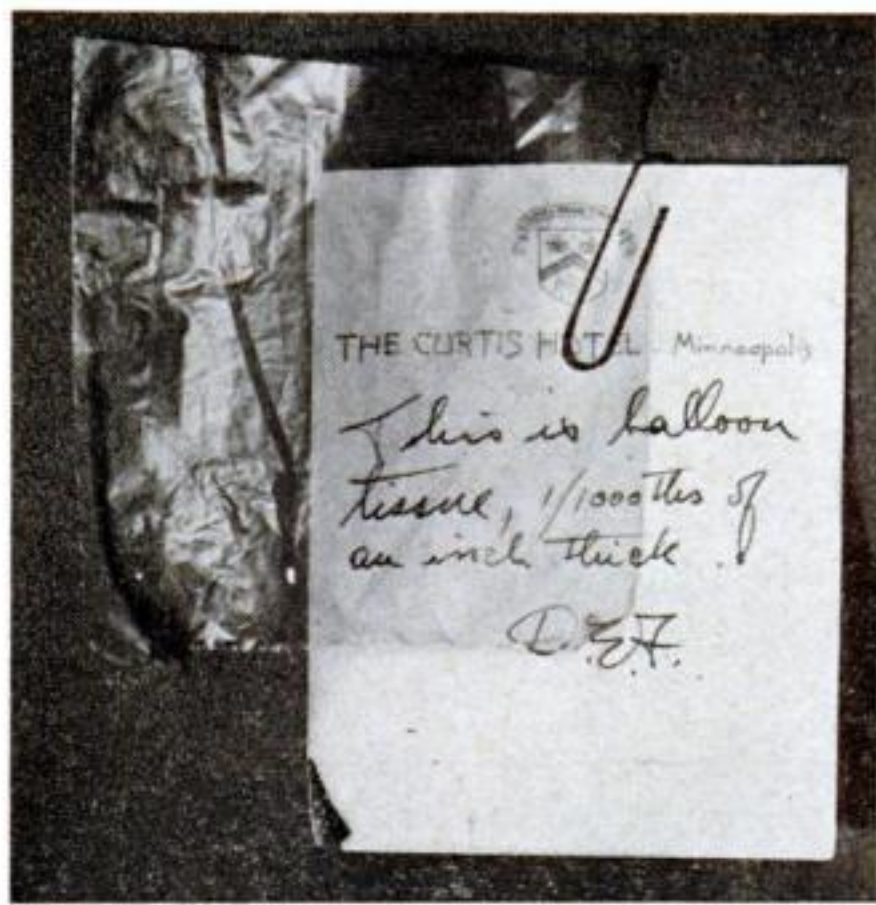
Yet the balloon is the focal point of observation from the ground. That is because

the answers to the questions asked by chemists, physicists, and others depend on its behavior. Presently an electric charge timed by a tiny motor will melt a bit of wire, a razor-edged knife will sever the load line above the parachute, and the instruments will start their long journey to the ground.

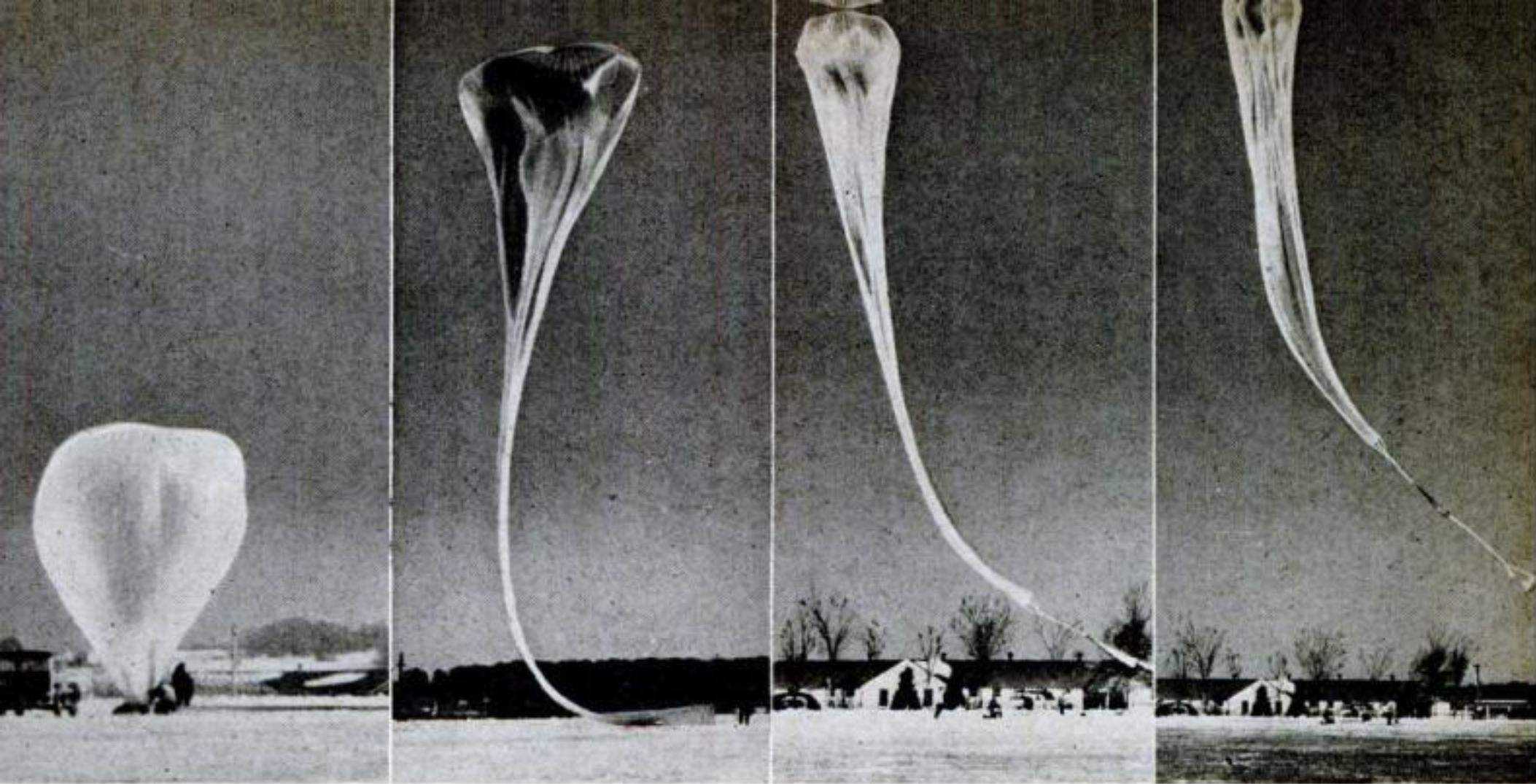
This is Project Skyhook. No explorations initiated in this postwar period are more pregnant with meaning for the future than this one, carried out by General Mills, Inc.,



Flow of helium from steel bottles into manifold, for piping to balloon envelope, is adjusted by technician. At start, only 1.3 percent of the balloon's capacity is filled by the gas.



Plastic balloon skin, forwarded to PS by reporter Francis, is polyethylene. It absorbs few infrared rays, and is unaffected by ultraviolet light, unlike some plastics, or by temperature.



At launching, helium bubble sails up, picking up load line. Apparatus weighing up to

70 lb. can be attached to it. Dark line seen in the final picture, far right, is the parachute.

of Minneapolis, for the United States Navy.

"Where our balloons now float," explained Otto C. Winzen, "will be man's highway of tomorrow." He is the young engineer who started the project and brought it to fruition for the Aeronautical Research Laboratories of General Mills.

Those balloons are probing a region that as yet is almost wholly unknown. A few conditions up there have been discovered. It is bitter cold—yet the sun's rays burn with fury far beyond that met anywhere on earth. Gravitational pull is practically unchanged. Winds often exceed 100 m.p.h.

But what about the composition of the air? The effect of cosmic rays on man and atomic structures? The speed of sound? What conditions will pilots encounter if wars are fought at that altitude?

Airplanes can't supply the answers. They can't get much more than half that high. Small rubber sounding balloons reach only the lower levels of the atmosphere. The record for manned balloons is only 72,395 feet. Rockets streaking up and down through this layer of the atmosphere go too fast to take adequate observations.

What is needed is an instrument platform that is relatively stable and motionless in relation to the air—one that will reach and hold a precalculated ceiling of around 20 miles for hours or even days.

Hence, a new kind of balloon. No balloon ever made before is like those of the Aeronautical Research Laboratories. Their skin

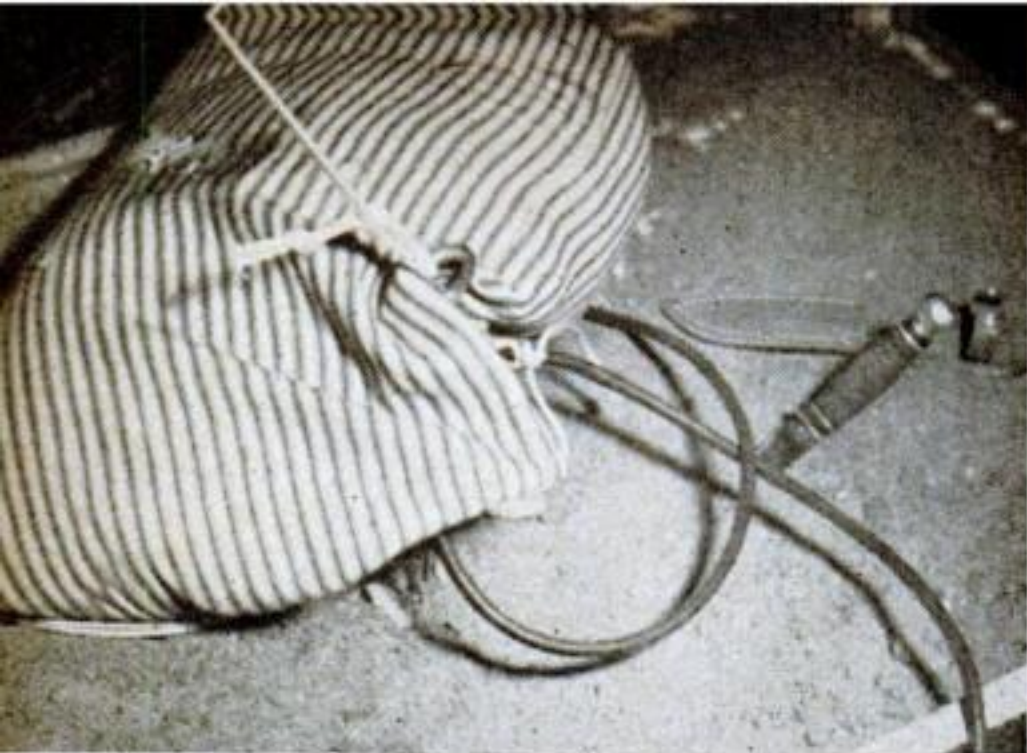
is tissue-thin. Yet these balloons carry a "payload" of 7/10 of their empty weight.

Science's secret weapon in this assault on the unknown is a plastic, polyethylene resin. Made by the Visking Corp., of Terre Haute, Ind., it weighs so little that one strong man can lift a whole deflated balloon.

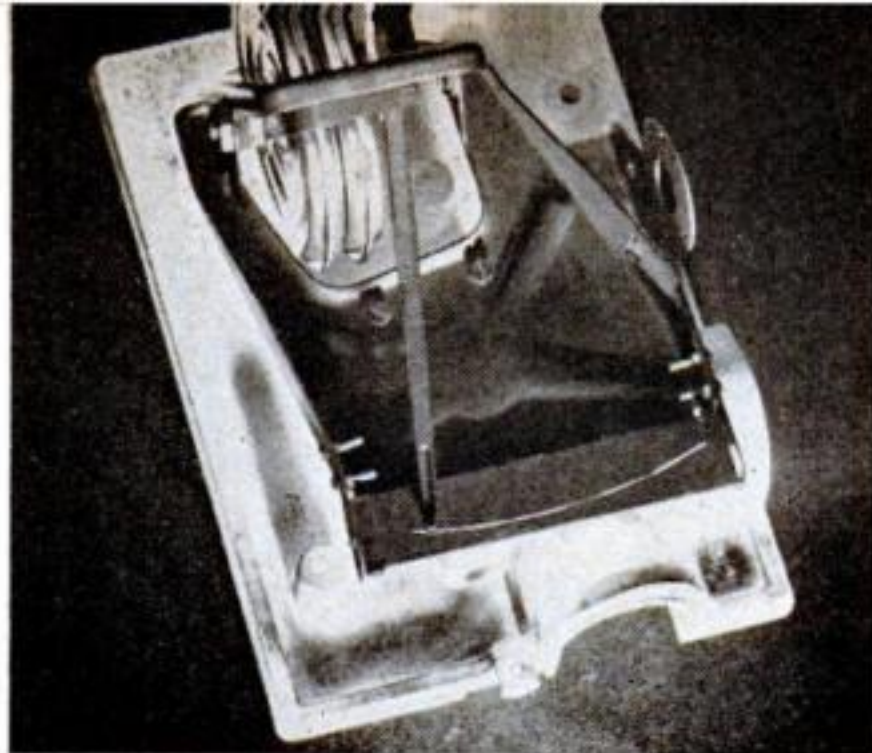
Radiosondes, parachutes, tiny radio transmitting stations, radar reflectors, cosmic ray counters, special telemetering equipment, and other devices, about which the govern-



Full 206,000-cubic-foot capacity of bag, when it has swollen to the size of several houses, is reached at 100,000 feet or so. If winds are high, bag may be blown out of sight in an hour.



Sandbag at anchor conceals secret device for cutting anchor line electrically at launching. Knife is used in emergency. Balloon will rise above normal airplane traffic in 12 minutes.



Aneroid cell—reliable only up to about 60,000 feet—uses air pressure to run this instrument that records altitude. During climb, stylus etches line on glass coated with lamp black.

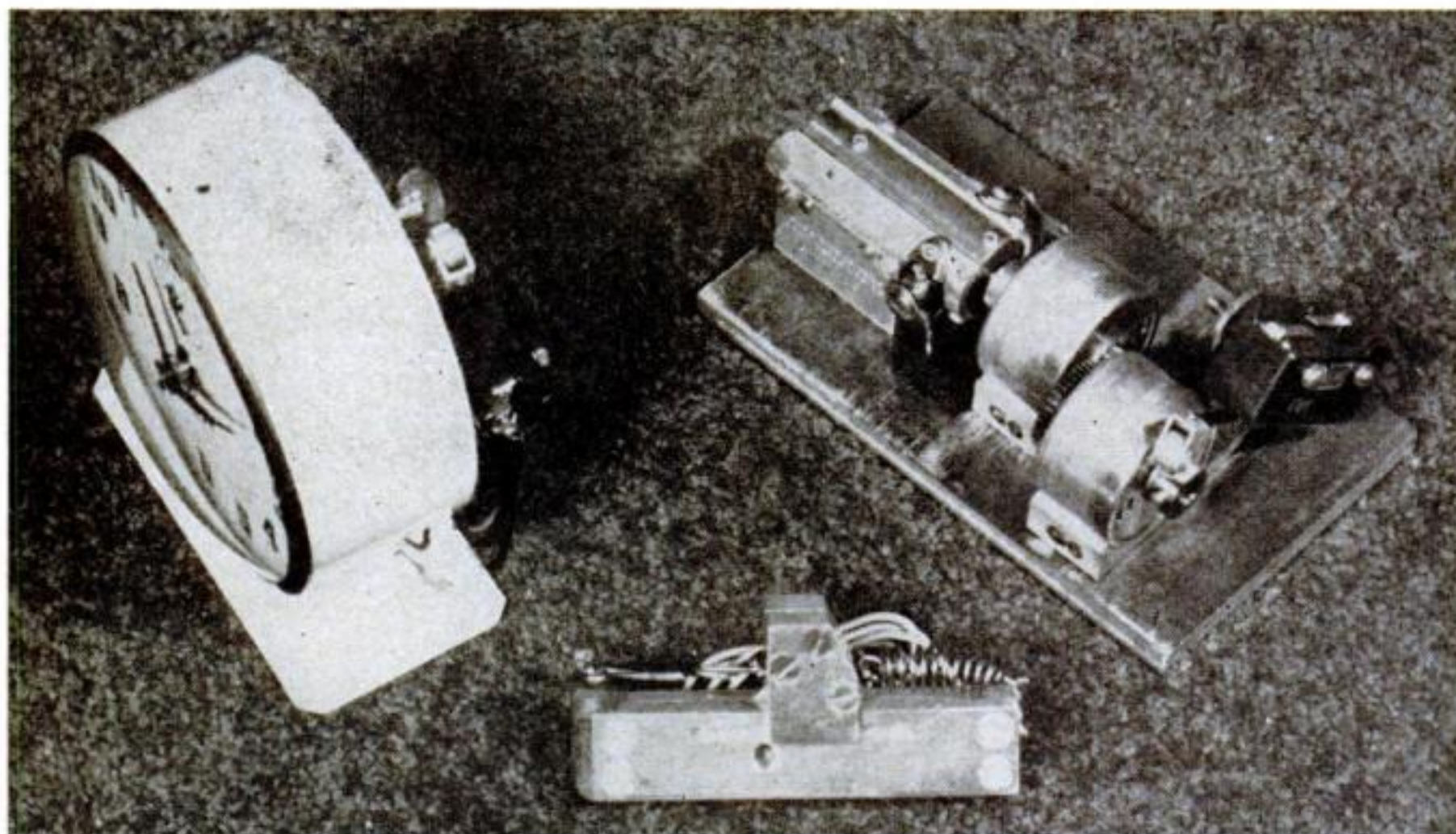
ment maintains secrecy, have been sent aloft under a single plastic bubble.

For excitement, the launching of a plastic balloon is the next thing to putting your last two dollars on a long shot at Hialeah. The weather must be good for observation. The wind cannot be too high: the plastic is fragile and subject to tearing.

First of all come safety precautions for other aircraft. The chances of collision are remote, but the Civil Aeronautics Administration and the Weather Bureau are advised of each flight in advance.

A ten-wheeled truck snakes a train of anchor, boxes, special launching equipment, a helium-bottle dolly, wiring for the electrical cutting of cords holding the load line, and other paraphernalia onto the field, about a hundred miles from Minneapolis. This permanent site was chosen because it is remote, free from intrusion, and off the scheduled airways.

The top of the balloon, where the helium bubble will develop, is laid out in the lee of an unused airplane hangar to protect it from the wind. The rest of the envelope is



Either alarm clock, far left, or miniature, battery-fed motor with reduction gear, far right, is used to time release of parachute. Shown between them is load-line cutter. Upper-air re-

search was started under auspices of Special Devices Center, Office of Naval Research, Port Washington, N. Y.; is directed by T. R. James, head of company's Aeronautical Research Lab.

strung downwind with all the gentleness of a mother's caress. As an extension of the downwind line, the load line, complete with its parachute and instruments, is hung on forked standards and anchored by boxes of sand. The load line must be put under exactly the right amount of tension. A slack line might cause an instrument to snap off when the helium bubble is released. That has happened.

The input of gas is measured volumetrically. Wind velocity and direction are checked minute by minute. If the wind shifts, the direction of takeoff must be aligned with it.

Now is the time. A tube, also of plastic, which has been feeding helium to the balloon is withdrawn. Wrenches close the gas bottles. The truck hauls away the dolly. One man prepares to release the bubble. Two others stand within sprinting distance of the anchor points—there may be an emergency. A hundred feet to the side a fourth man will close successive circuits to chop the anchor cords.

The man in charge picks up a megaphone. "Set?" The men downwind respond individually . . . "All set."

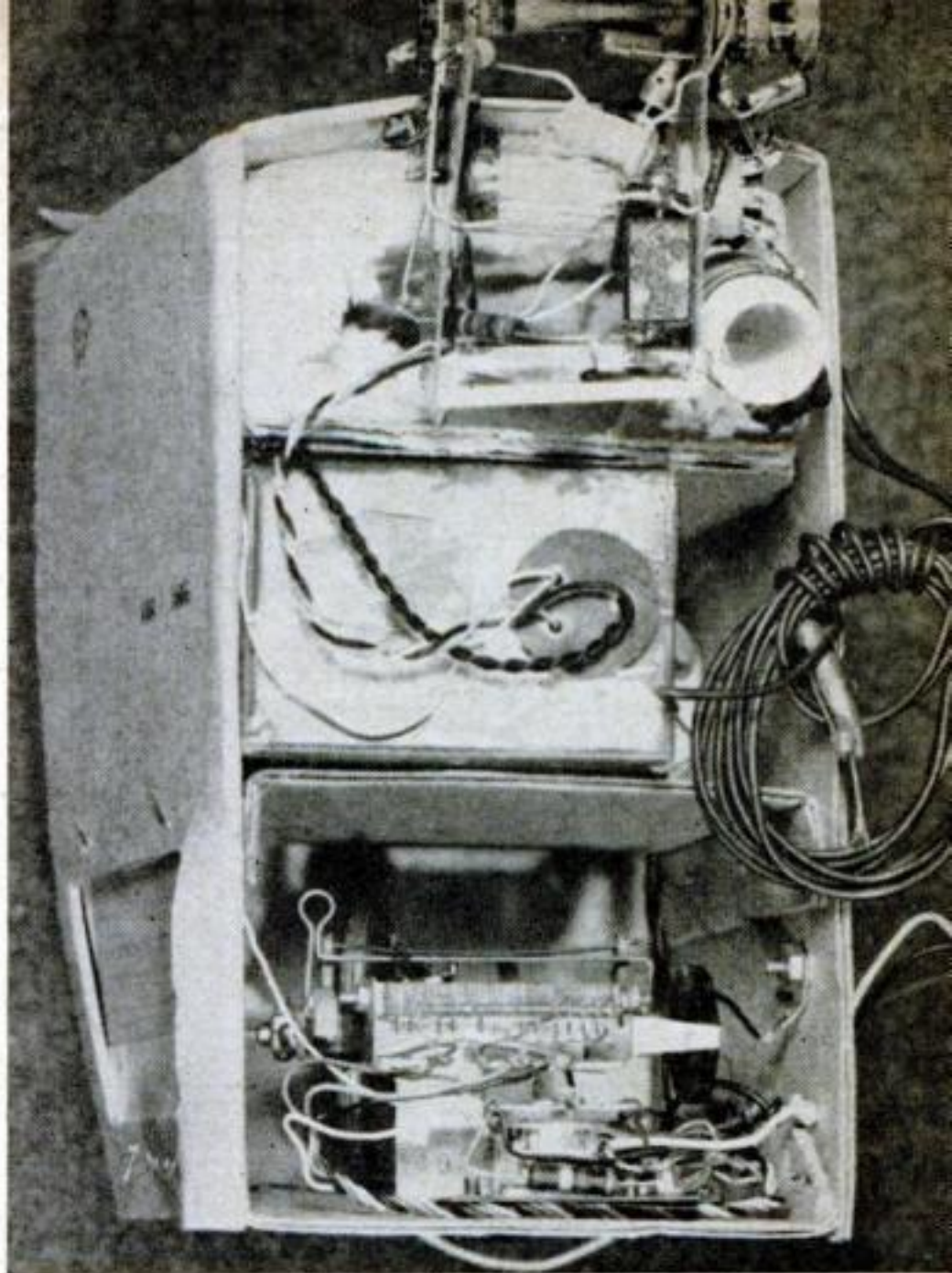
The bubble soars. As it picks up the folds, the balloon becomes a cobra. For a second or two it writhes. It weaves. Now it has seized the load line. Up goes the parachute. As fast as the tongue can name them off, instruments, radar screens, radiosonde, and finally a bag of sand for ballast are airborne. The sand bag goes along only if there is a shortage of instruments, sent in for the flights by colleges and other institutions collaborating on fundamental upper-air research.

Tracking a Soaring Laboratory

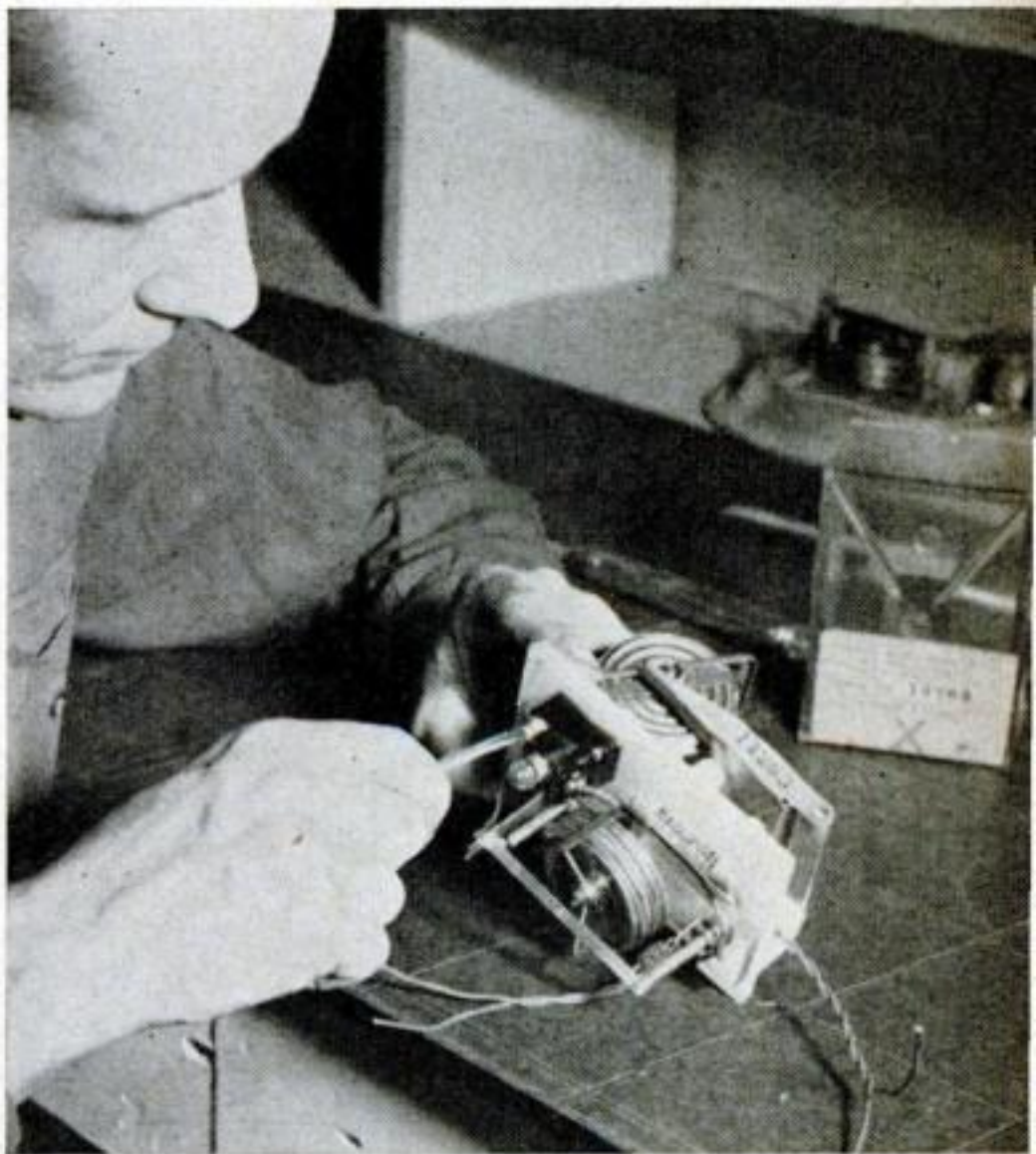
The work has only begun. Now the balloon must be tracked. Its trajectory supplies valuable meteorological data. One man goes to the theodolite. The rest of the crew clumps upstairs to the field control tower above the hangar.

Tracking is going on in other places, too. Within a diamond-shaped pattern 100 miles long and 60 wide, observers aground are sending in azimuth and elevation reports as frequently as once a minute. Radio direction finders and radar equipment are trained on the balloon. Four shortwave radio communication stations correlate all this information, and it is entered on charts for future study.

Not much more than an hour has passed;



Radiosonde contains, from top, tiny radio sender, battery, and baro-switch unit. Switch, run by aneroid cell, selects circuits for sending back temperature, humidity, and air pressure.



Aneroid-tripped electric light is hitched to parachute to warn aircraft when descent is made after dark. Cell cocks on way up, switches on flashing light at 20,000-foot level on way down.

the balloon has levelled off at about 100,000 feet, its ceiling. Through the theodolite telescope it looks like a translucent pear, less than half the size of a pea. Its load is not visible. Even if the parachute were large enough to be seen, its red color would reflect no light to the eye.

Hours of methodical receipt and entry of reports on the balloon's course go by. Suddenly the man on the theodolite reports: "Parachute's cut loose! Balloon's in four pieces!"

A telephone rings. "Right," says the man on duty, answering, "four pieces at 4:27. We caught it." That was an observer calling in. A voice pages the tower on the short wave: "Broke into four pieces at 4:27."

Shock from inertia forces alone, induced by the balloon losing its load, destroys the delicate envelope to keep it from wandering around aimlessly in the sky.

The day's chores are done now. In anywhere from a half hour to an hour the parachute will touch the ground and collapse. Attached to the radiosonde are directions for the finder: Please ship the parachute and instruments back. That system is unavoidable. Only now and then can the parachute be tracked by radar.

Few parachutes and instruments have

been lost, out of scores of flights. Some remitters don't use their heads, of course. One cut a couple of precious shroud lines off the parachute to wrap his package for the post office. Another man, a trapper who stumbled on the gimmicks in the wilds of the north country, pulled his gun and shot up a couple of instruments.

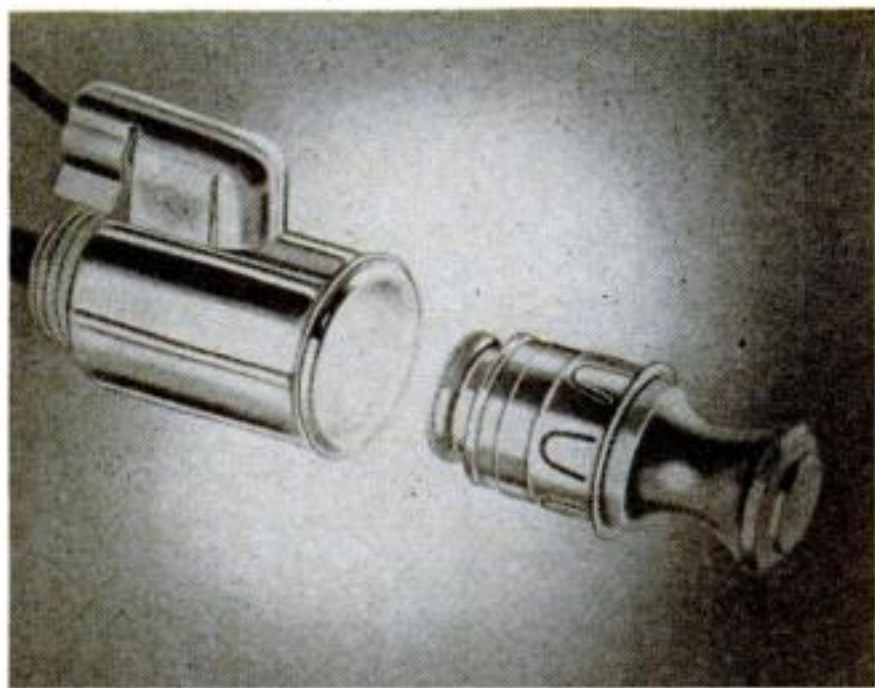
The project is still experimental in that research never ends. For example, around 70,000 feet the radio transmitters may begin arcing between terminals because the air becomes too thin to act as a non-conductor. Something must be done about that.

Temperature-measuring equipment is also inadequate. It gives, not the temperature of the free air, but that of the air plus solar radiation effect. No instruments have yet been developed to measure pressure and dew-point accurately between 80,000 and 100,000 feet and telemeter the data back.

These are details. The end product of upper air exploration is a better understanding of our planet. Cosmic radiation and meteorological research alone will yield results that will benefit all mankind.

That realization helps the men get their feet on the floor when the alarm goes off at 3 a.m., signaling another day to fly a balloon.

END



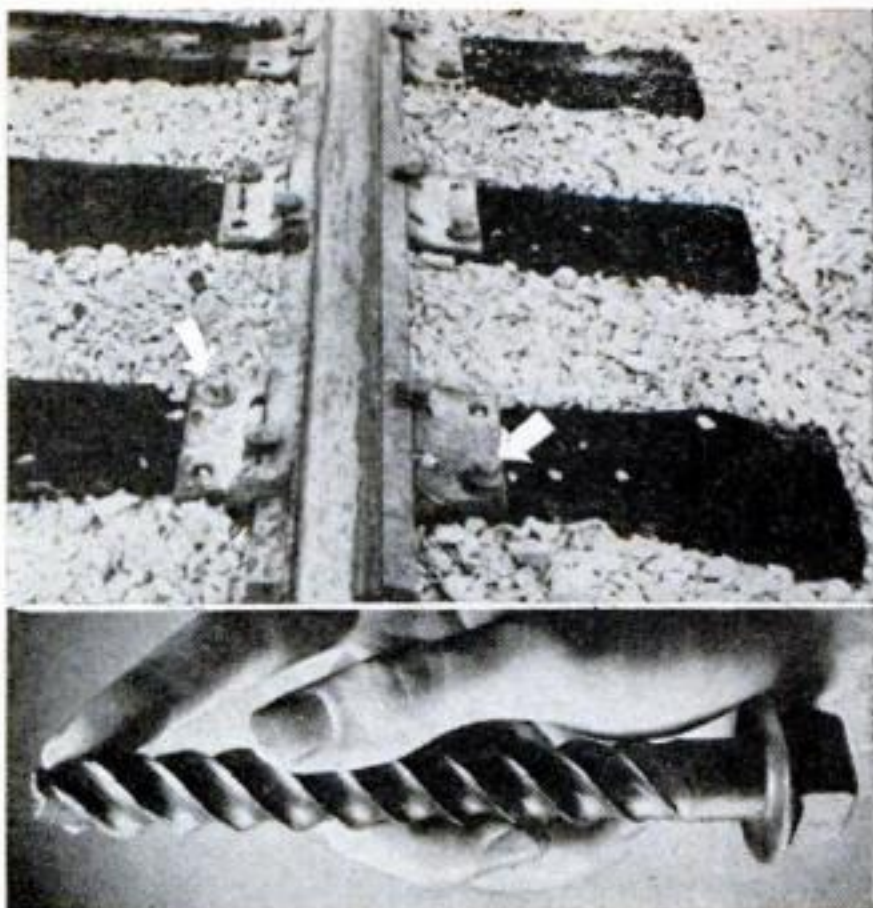
Cigarettes in the Dark

HAVE you ever fumbled getting the "pop-out" cigarette lighter back into its dashboard well at night? You won't have that trouble with this new Vis-O-Lite [®]. As you light up, the receiving well glows so that you can't miss it on the return journey. According to the manufacturer, Casco Products Corp., of Bridgeport, Conn., the new lighter not only keeps your eyes on the road, but prevents dashboard scratching.



Pouch Fills Pipe

TOBACCO stays fresher in a new plastic pouch, and smokers can pack a pipe without spilling tobacco. The pistonlike action of the plunger, shown extended above, pushes tobacco into the pipe and tamps it firmly in the bowl. To close the pouch, the plunger is pressed back into place and locked by turning the knob at its end. Made by the Phil-O-Matic Co., of Springfield, Ohio, the pouch fits into the pocket of a shirt.



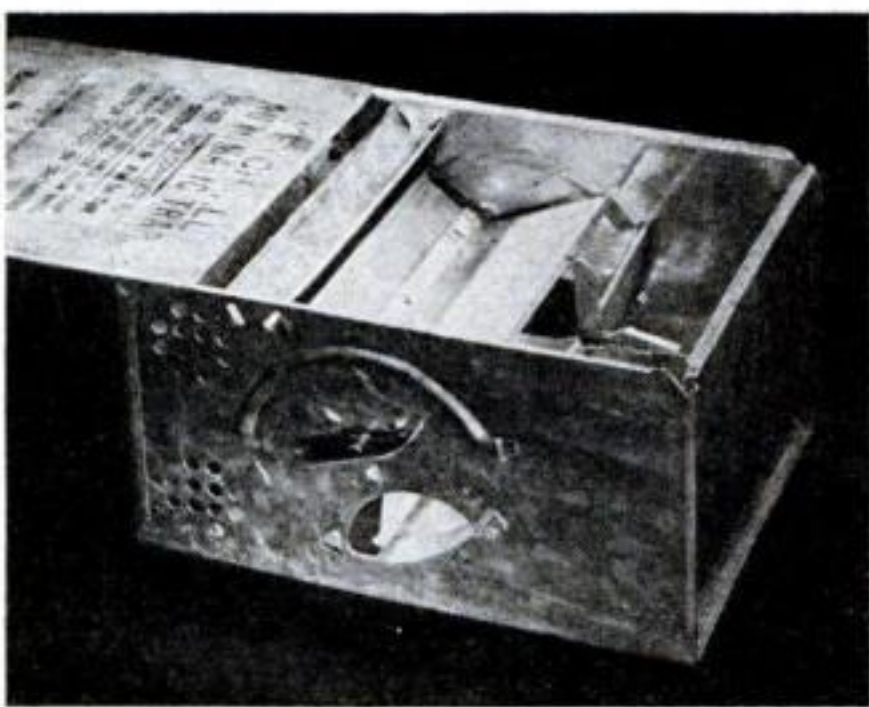
Rails Held Rigid

THE danger of spreading rails is reduced by this new corkscrew railroad drive spike developed by the Oliver Iron and Steel Corp., of Pittsburgh, Pa. It replaces the standard outside spike to fasten the tie plate securely to the tie (arrows). A hole is first drilled, and the spike driven in; the thread grips the tie so that each spike will hold as much as 25,000 lb. Once in, the spike must be unbolted with a wrench.



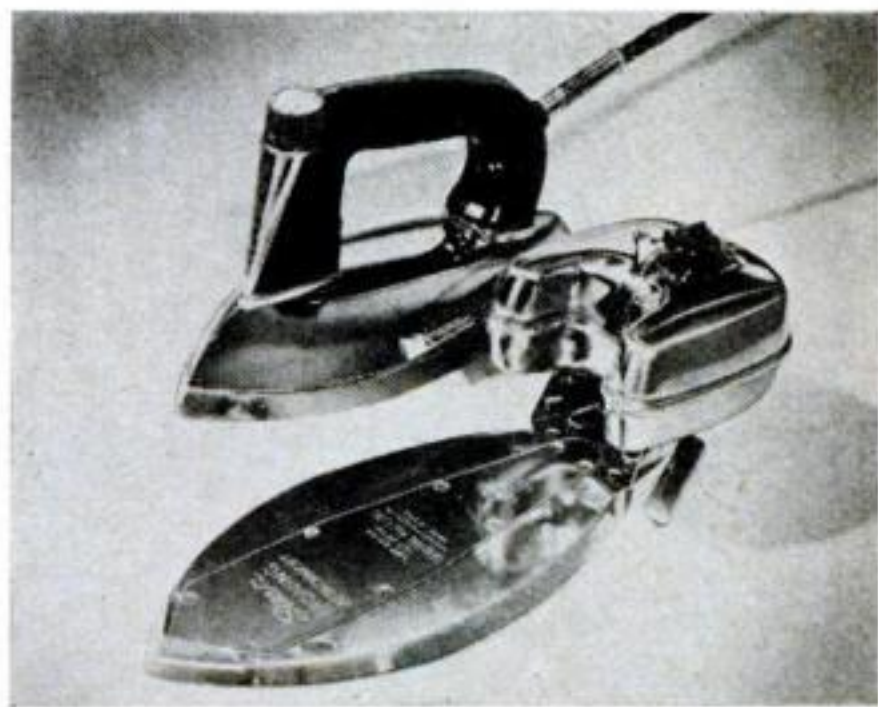
Blizzards on Call

WITH this machine snow falls on Hollywood, from a blizzard to a gentle flurry, just as the director wants it. The tank at left holds a fire-extinguishing chemical. Mixed with water and air, it is fed into a perforated aluminum drum revolving in front of a fan that blows the storm over a movie set. The machine can pile snow up to any desired depth, and it melts on an actor's clothing in a few minutes, just like the real flakes.



Curiosity Traps Mice

NO BAIT is needed to catch mice in this automatic Ketch-All [®] mousetrap. Curiosity entices a mouse to enter, from either side, a runway in the trap. Once inside, the victim steps on a treadle, releasing a shutter that sweeps him into a cage, still alive. The maker, Kness Manufacturing Co., of Albia, Iowa, claims that 25 mice can be caught with one setting. Winding a key sets the trap.



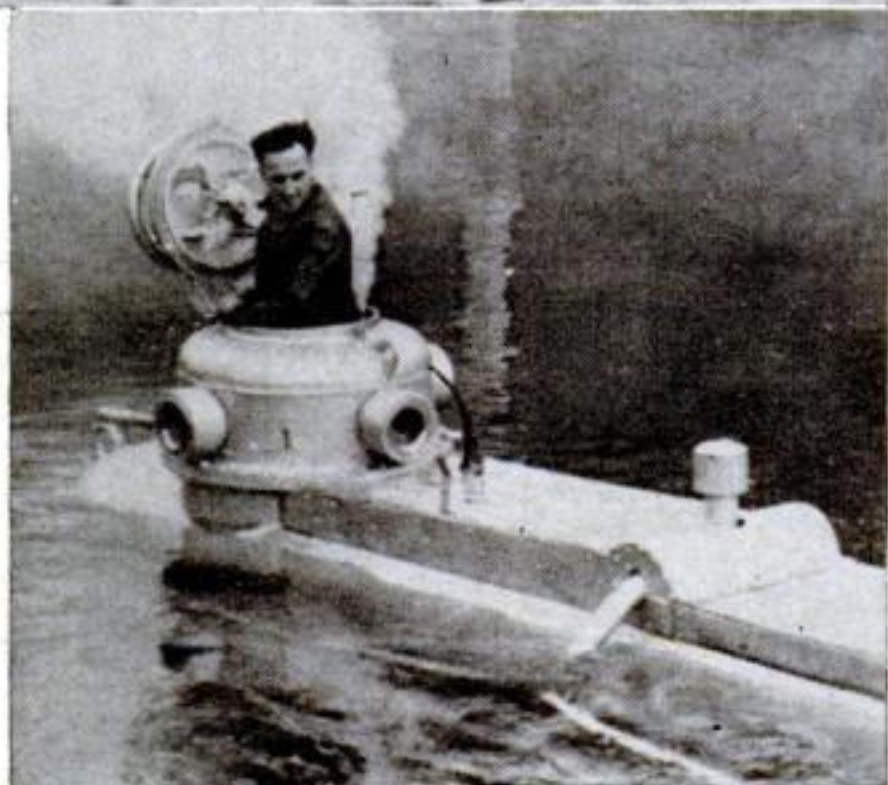
Pressing Problem Solved

HERE'S a two-in-one combination that gives you steam for ironing without pre-dampening and for pressing without a dampened cloth. The steam attachment, in foreground above, is an auxiliary base that slips under a General Mills electric iron, also illustrated. Resembling an outboard motor, the tank holds 1½ cups of water, providing enough steam for 45 minutes of ironing.



Tiny Sub Is Deep Diver

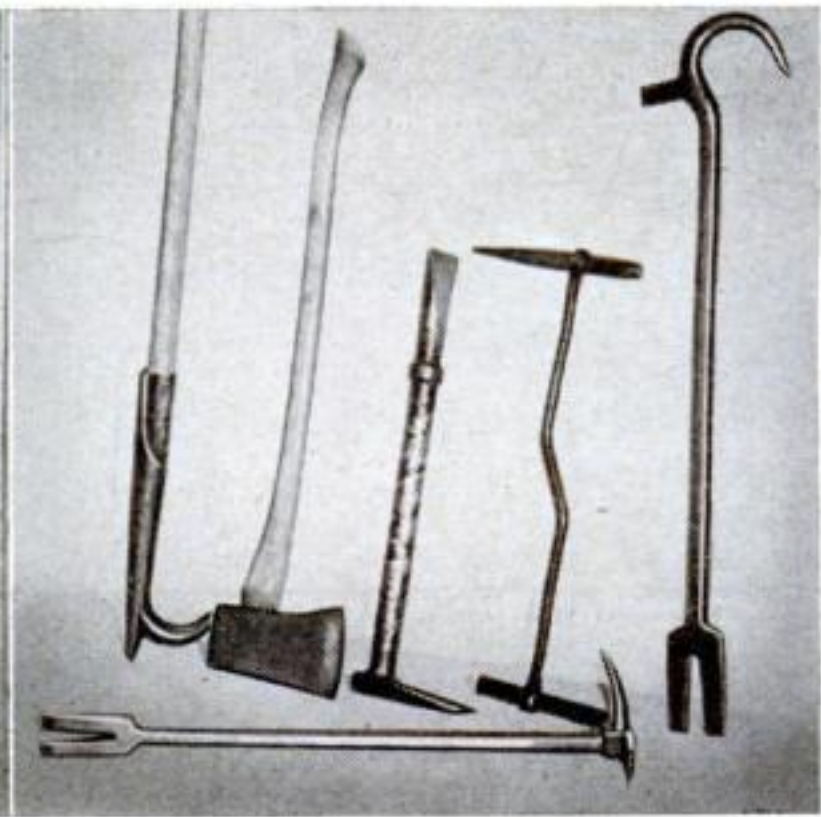
SUBMARINE history is in the making if the one-man sub, shown above about to submerge, lives up to the claims of its Italian designer, Alberto Vassena. It is reported that in tests at Lake Como, the craft went down 771 feet. (700 feet is reported "bottoms" for war-developed German subs). Vassena, shown in turret at right, hopes to go down 1,312 feet, and claims that he could do better except that that is the deepest point of the lake. For salvage purposes, the craft has a motor-operated lifting device fixed to its bottom, said to have a hoisting capacity of 10 tons.



Lightweight Tool Gives Firemen New Weapon

FIRE fighters often have to crash through a door or wall to reach a blaze in a hurry. A new, lightweight tool, being used by the fireman below to break open a lock, does the job of all five of the tools shown lined up at

right below. These weigh 49½ lb. as against the 8½ lb. of the new all-in-one tool seen at the bottom of the picture. It was developed by Deputy Chief Hugh A. Halligan, of the New York City Fire Department.





By George H. Waltz, Jr.

Emergency methods and new materials may bring radical changes in ancient craft

The headline on this page was set by placing cardboard letters in a Fototype composing stick. The author's name and the two lines below it were set the same way. The result is one of printing's new looks. Another is the type you are now reading, which was set on a Vari-Typer.

There is hardly a large printer or publisher who is not jealously guarding and developing at least one new printing wrinkle that he regards as "top secret." Even the list of new inventions that are known and can be talked about is a long one. It ranges from automatically produced plastic printing plates to a revolutionary new electronic printing press in which the ink literally jumps from the printing plate to the paper.

This revolution in the business of putting words and pictures on paper has been a long time coming. Except for refinements and mechanization in the form of automatic type-casting machines and rotary presses, there have been no radically basic changes since the 15th century, when Johann Gutenberg first used movable metal type to print Bibles.

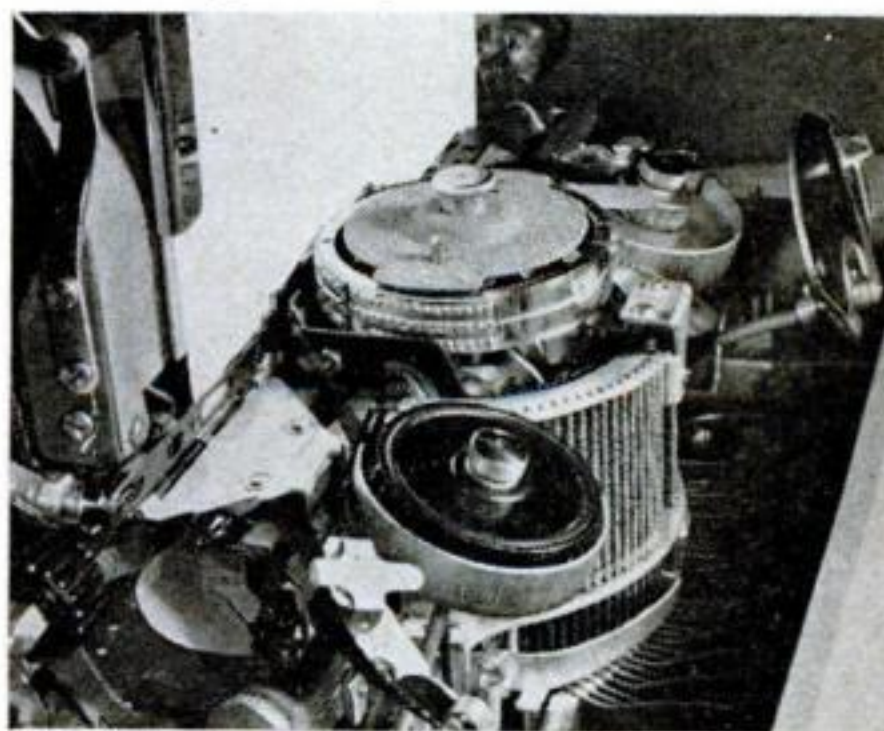
But 1948 certainly looks like a year for innovations.

Seven months ago, Chicagoans saw a new kind of newspaper. The pages looked as though they had been typewritten rather than printed. And, in a way, they had. The publishers had used a special kind of typewriter that spreads the letters

out to fill each line. It was the first time this system had been used by a big city's daily newspapers. The Chicago publishers have proven that papers can be issued this way, but have found it a comparatively slow process, forcing them to advance many of their deadlines.

A labor dispute was responsible for the change-over. If it spreads, POPULAR SCIENCE and other magazines may be issued the same way.

The normal printing procedure of most newspapers and magazines starts with assembling the type for each line and casting it in the form of a metal slug. These slugs are produced automatically



Close-up of the Vari-Typer's type cylinder. When a key is pushed down, this cylinder turns to bring the right letter into contact with a carbon ribbon.

by a type-casting machine. A skilled operator, sitting at a keyboard, "types out" the copy provided him. As he hits the key for each letter, a metal mold for that letter, called a matrix, drops down into its proper place.

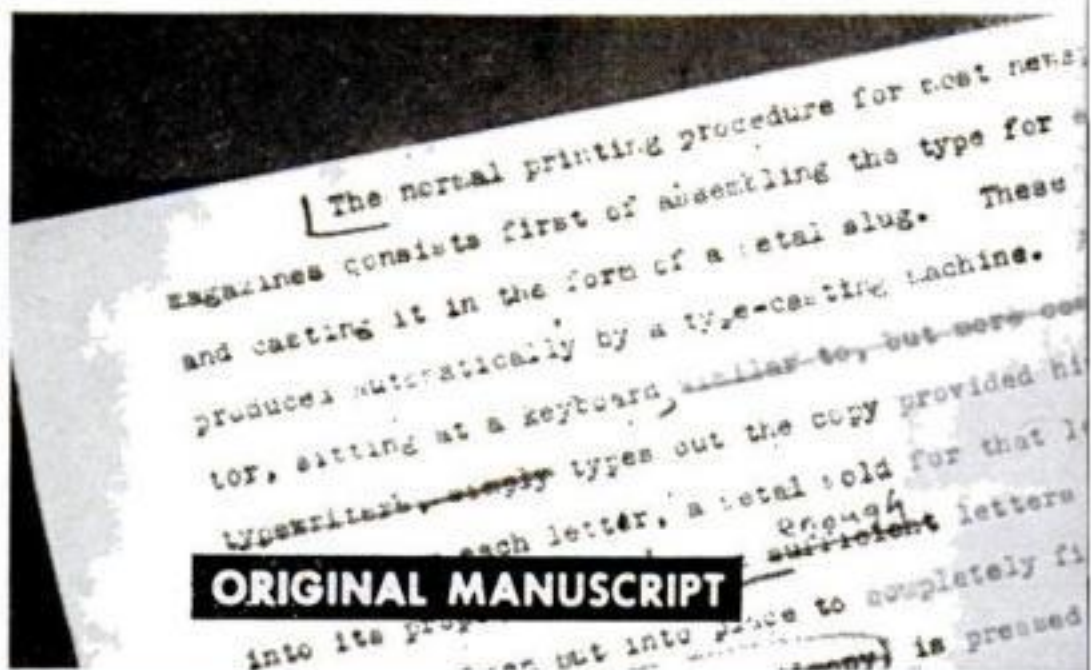
When enough letters and compensating spaces have been put into place to completely fill a line, molten type metal is pressed against the line-long mold, and a complete line of type is cast. This process is repeated for each line. These lines are assembled into pages from which the actual printing plates are made.

Last November, Chicago's newspapers suddenly found themselves without operators for their type-casting machines. Borrowing a few tricks from the tricks used to reproduce photographs on a printed page, the publishers turned to the art of photoengraving. Instead of producing molds and casting the individual lines of type for each page, they could carefully typewrite their news stories to approximate column width. The columns, assembled into pasted-up pages, could be photographed, and then a printing plate could be made by the photoengraving process.

There was only one hitch. Newspaper readers are accustomed to even lines that begin and end flush on both sides -- not lines that are uneven along the right-hand margin, like those that come from an ordinary typewriter. For the solution, the publishers turned to the Vari-Typer and the IBM Executive Typewriter. These automatically adjust the spaces between letters and words in a line to make it come out flush at both ends.

The copy, however, must be typed twice. A first typing, gauged roughly to full column width, is necessary to determine just how much space must be added or subtracted to fill a line. At the end of each line, the typist indicates how much space must be put in or taken out. This step is called "pre-typing."

The rough copy, with its space notations, then goes to the operator of the Vari-Typer. If she wants to expand a line, she sets a dial to the number of spaces indicated by the pre-typist; to condense a line, she operates a special key. The Vari-Typer automatically does the rest -- adding or subtracting the right amount of space between characters to fill the



Working from the author's original manuscript (top), first step in preparing Vari-Type copy is typing roughly to column width. This is called pre-typing.

line out to the width of a full column.

In the next step, the typed columns, together with copies of illustrations, are assembled into pages by pasting them in their proper positions on sheets of cardboard. These pages are photographed and the negative is used to produce a zinc etching. From these master etchings, the final printing plates are cast.

In the normal photoengraving process, a specially treated zinc plate is exposed to the negative. When the plate is placed in an acid bath, only what corresponds to the white spaces in the original copy are attacked or etched by the acid. The result is a plate with raised letters similar to ordinary type.

A revolutionary new engraving machine, recently unveiled by the Fairchild Camera and Instrument Corp., of New York, elimi-

opera-
hits
down
casting
molten
the line-
process in

Or that letter, called a matrix, drops
down into its proper place.

When enough letters and compensating
spaces have been put into place to com-
pletely fill a line, molten type metal is
pressed against the line-long mold, and
a complete line of type is cast. This
process is repeated for each line. These
lines are then set in galleys from which
printing plates are made.

PRE-TYPED COPY

When enough letters and compensating
spaces have been put into place to com-
pletely fill a line, molten type metal is
pressed against the line-long mold, and
a complete line of type is cast. This
process is repeated for each line. These
lines are assembled into pages from which
the actual printing plates are made.

VARI-TYPED COPY



Pre-typed copy then goes to the Vari-
Typist. Following notations at end of
each line, operator adjusts a dial to add
space needed to fill the line exactly.



The Vari-Typer automatically expands a
line. A special key is used to condense
a line. The result is a column, as shown
above, with an even right margin.

NEW INVENTION PROMISES TO REVOLUTIONIZE PRINTING

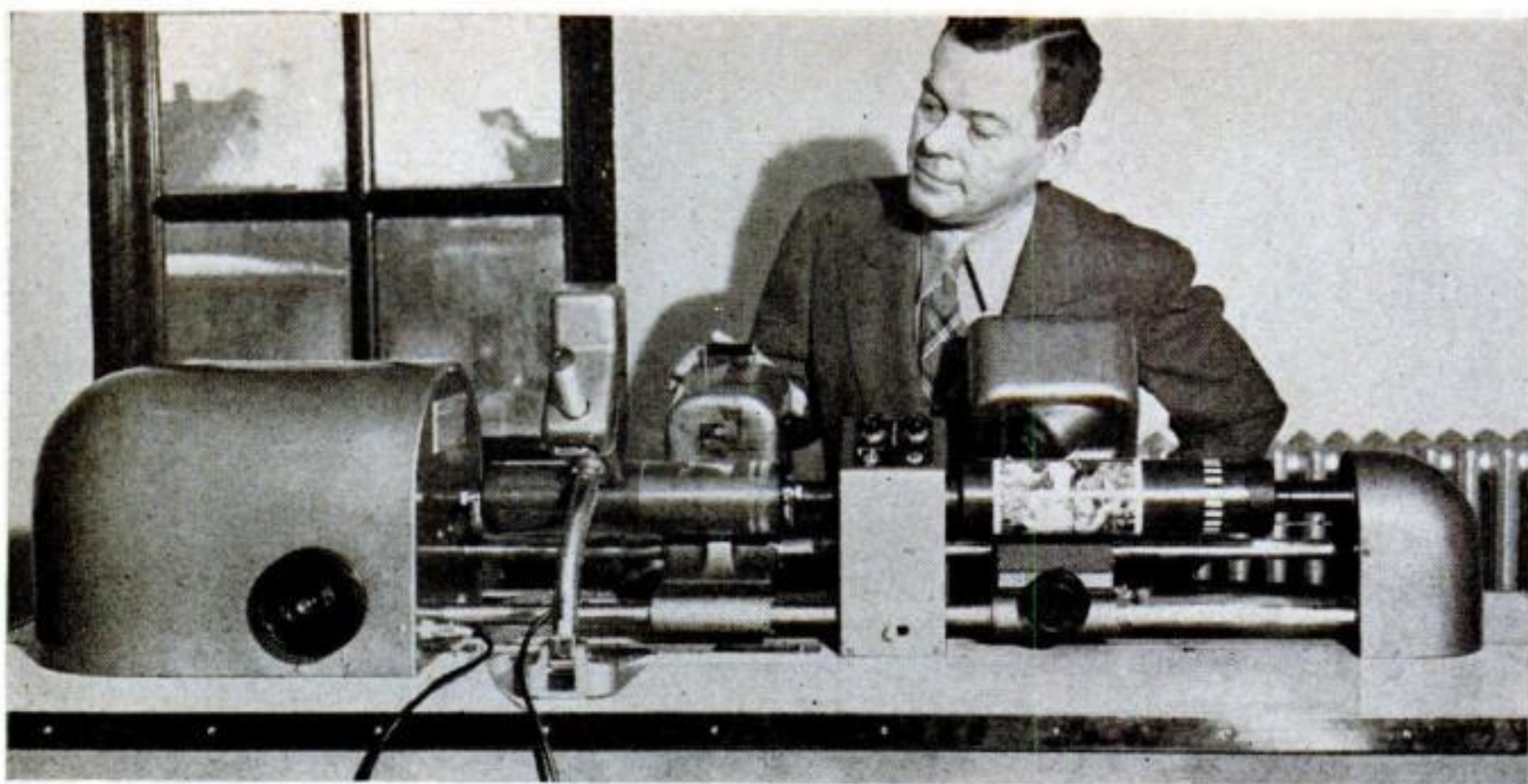
NEW YORK, N.Y.—The Ralph
C. Coxhead Corporation of New
York makes the announcement of a
new invention, a machine which
permits type composition in the
office by an office typist.

The machine resembles a type-
set in appearance and

Mr. Coxhead points out the
interesting parallel of his new
invention and the history of print-
ing itself. The modern printing
industry was born in 1448, exactly
500 years ago, when Gutenberg
invented the movable type press.
The Renaissance period got off
to a start when the Gutenberg

As this story went to press, a new and
improved Vari-Typer was announced by the
manufacturer. As shown in the work sam-
ple above, the machine not only squares

the margins but also automatically allows
wider spacing for wide letters like "m"
and "w" and narrower spacing for narrow
letters like "i" and "l."



An electronic shortcut for making photo-engravings, this machine needs only one operator. Above, the inventor, George Washington, Jr., is resting his right

hand on cylinder holding the engraving stylus. At left is a microscope for making tonal adjustments. Right of center is the scanning electric eye.



The finished product as it comes off the Fairchild-developed photoelectric engraver. The lightweight plastic cut is next mounted on a wood or metal base.

notes the need for chemicals, cameras, or highly skilled workers. In it an electric eye replaces the photographic negative, an electrically operated and heated stylus takes the place of the etching acid, and a sheet of lightweight plastic is used in place of the zinc. Entirely automatic, it can produce a column-wide newspaper cut in 3 minutes and 40 seconds.

The new engraving machine resembles a small bench lathe. It has two long cylinders mounted along the same axis, and two

carriages of "heads" that can be moved along the cylinders at a fixed and synchronized rate. One head contains a photoelectric cell that serves as a scanning device. The other holds the stylus. In operation, the photograph that is to serve as the copy for the engraving is placed on the right-hand cylinder under the photo-electric scanner. A sheet of plastic is placed around the cylinder under the heated stylus.

In effect, the machine is a picture transmitter and receiver rolled into one. It literally sends a picture to itself. The photoelectric cell scans the photograph, turning its lights and darks into electric impulses. At the same time the stylus moves along and, actuated by impulses from the photocell, jabs small, pyramid-shaped depressions in the surface of the lightweight plastic sheets.

These depressions correspond to the lights and shades of the photograph. The result is a conventional half-tone pattern of dots. This plastic engraving then is trimmed, washed, and mounted on a metal or wood base.

Another new advance in the making of printing plates is the use of lightweight magnesium. The conventional stereotype plate for a newspaper page weighs 46 pounds; an engraved magnesium plate of the same size tips the scales at nine pounds.



Type casting the easy way. The simplified electric Kellogg Type-O-Writer, above, can be handled by any good typist. It fits over the complicated Linotype key-



board shown at right. Tapping of Type-O-Writer keys operates keys of the type-casting machine. The keyboard can be attached to any slug composing machine.

These lightweight plates are easier to handle and permit higher press speeds.

Still another innovation is the Type-O-Writer, developed by the Kellogg Switchboard and Supply Co., and now being used by one of Chicago's largest printers. It eliminates the need for skilled operators. It consists of an electrically operated standard typewriter keyboard fitting directly over the keyboard of the type-casting machine. Any good typist tapping out words on its 45-character keyboard operates the more complicated 95 keys of the type-casting machine.

Going one step further, another system makes it possible to operate a type-casting machine by remote control, even from another city. Operated like a teletypewriter, the machine produces a tape perforated in code that can be fed into an attachment on a type-caster, operating the latter's keys.

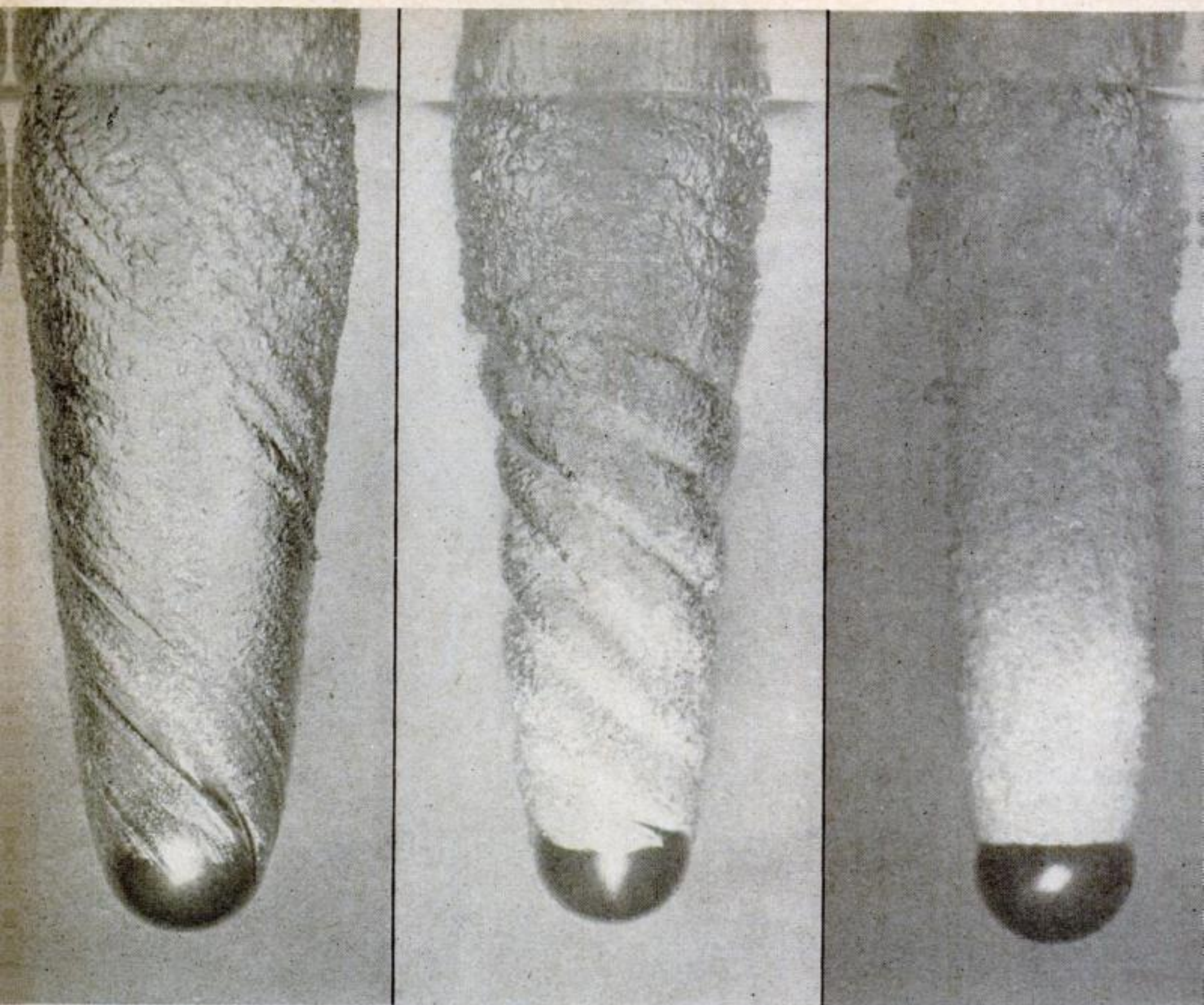
The publishers of Time Magazine now use such a system. Operators in New York tapping on typewriterlike keyboards can telegraphically punch tapes to operate type-casting machines in Philadelphia, Chicago, and Los Angeles. With this setup it would be possible to set a story here while the reporter is writing it in London or Paris!

Then there is the Fotosetter. It eliminates the need for type-casting machines entirely -- at least in offset printing.

It does away with the intermediate steps of setting type, preparing a perfectly printed proof of that type, and photographing the proof to obtain a negative for engraving. The Fotosetter operator simply types out his copy on a keyboard and the finished negative -- not type -- comes out. The Government Printing Office has been testing a machine since 1946.

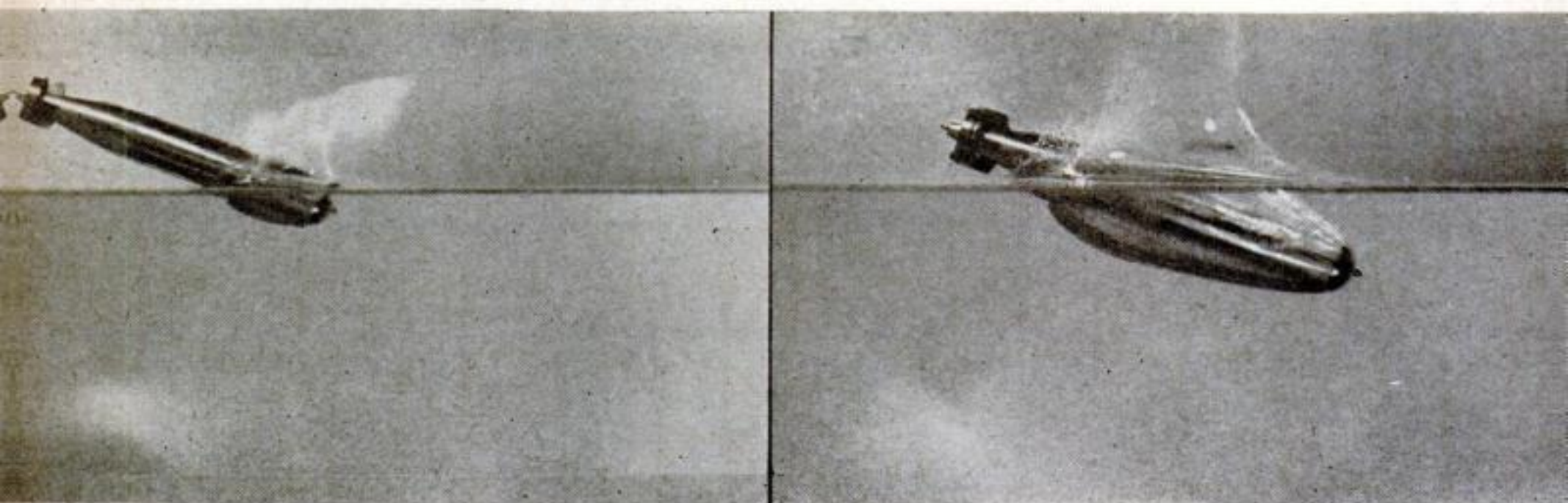
Since the top speed possible with any printing press depends to a large extent on how quickly the ink dries, researchers are playing with all sorts of new rapid-drying inks. Already available are cold-set inks that are applied hot, and dry instantly when they come in contact with the cold paper; moisture-drying inks that (like cements that set under water) set when allowed to absorb moisture; and pressure-drying inks that depend on the printing pressure to squeeze out the moisture and dry them.

One of the most revolutionary of all the new printing processes in the offing employs a "jumping" ink. Called the Electronographic Printing Press, it, like more and more of our modern machines, depends on electronics for its operation. In the Electronographic Press, the paper never touches the printing plates. Instead, the ink, electronically controlled, literally jumps through the space of a small gap from plates to paper! **END**



Three-inch steel balls leave curious patterns—and valuable hydrodynamic data—in their wake when they are dropped into a laboratory tank and photographed at $1/500,000$ second. In

this test, the balls (from left to right) were spinning at 24, 80, and 120 revolutions per second after dropping from a solenoid located 12 feet above the surface of the water.



Starting its run, the miniature hits the water at 143 feet a second, tossing up tiny plume,

then burrows an oddly shaped hole in the surface. Exposure time here was 10 microseconds.

Torpedoes From Crossbow Help Navy Improve Aim

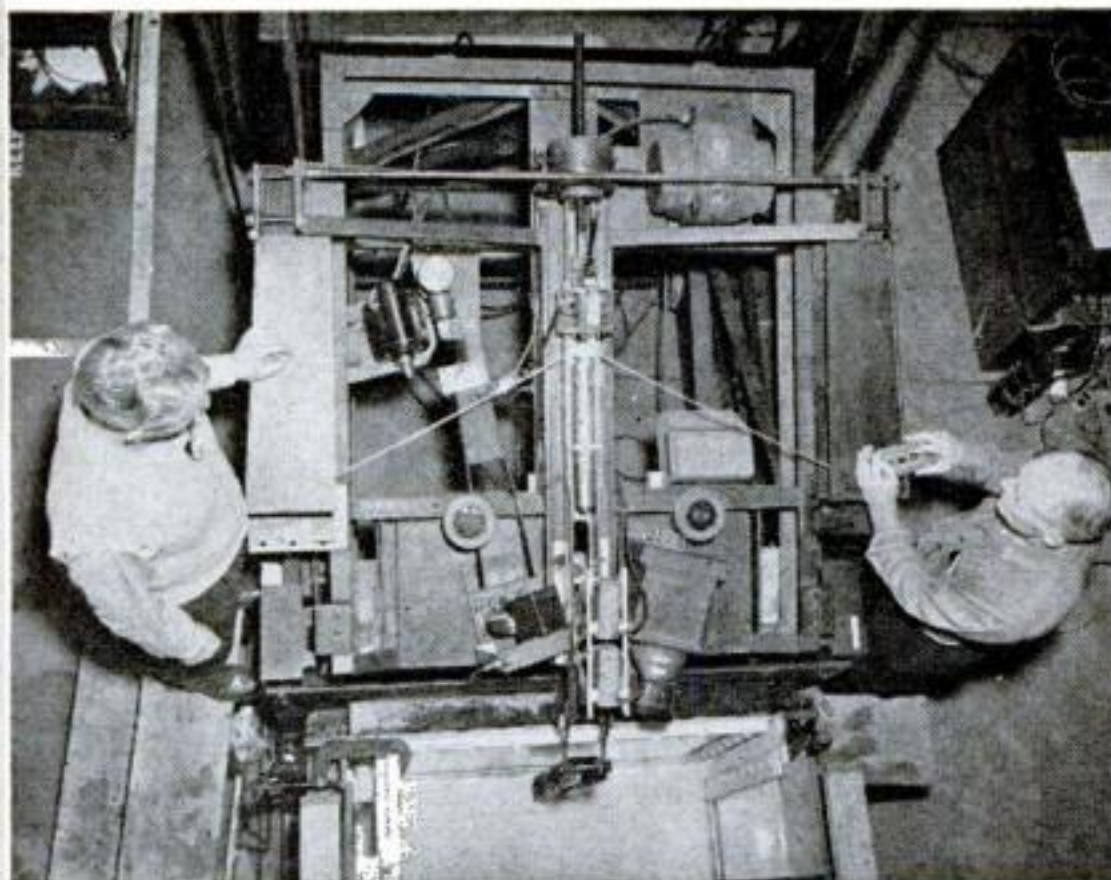
USING a mechanized crossbow and a 300-foot "pea shooter" instead of airplanes, the U. S. Navy is hard at work giving its lethal aerial torpedoes a sharper punch.

An artificial lake takes the place of the ocean at Morris Dam, in California, where the program is being carried out. There more torpedoes have already been fired than our aircraft launched against Japanese ships during World War II. Almost every conceivable shape for underwater missiles has

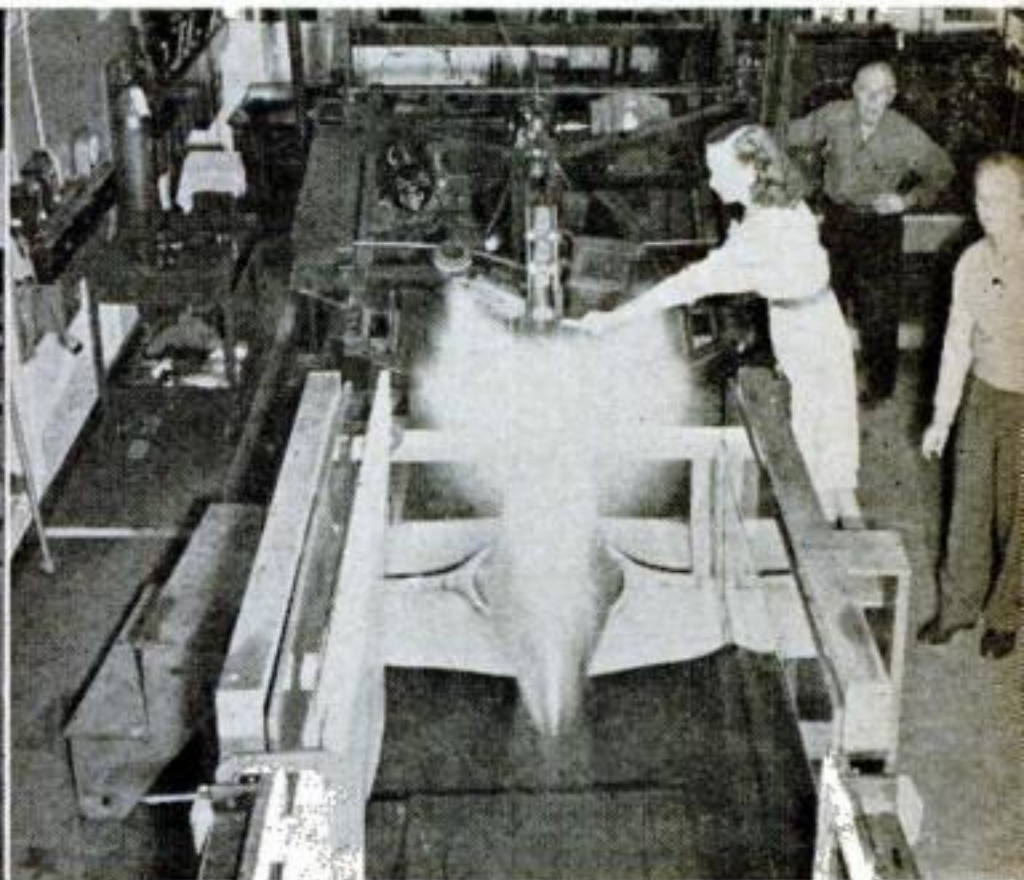
been tested, and a lot of the complex problems of hydrodynamics—problems concerned with whether a torpedo hits or misses—have been solved.

Miniature test missiles are fired into a laboratory tank by the crossbow method, which permits a variety of speeds and angles. High-speed cameras record their performance in microsecond exposures that show the slightest inaccuracy.

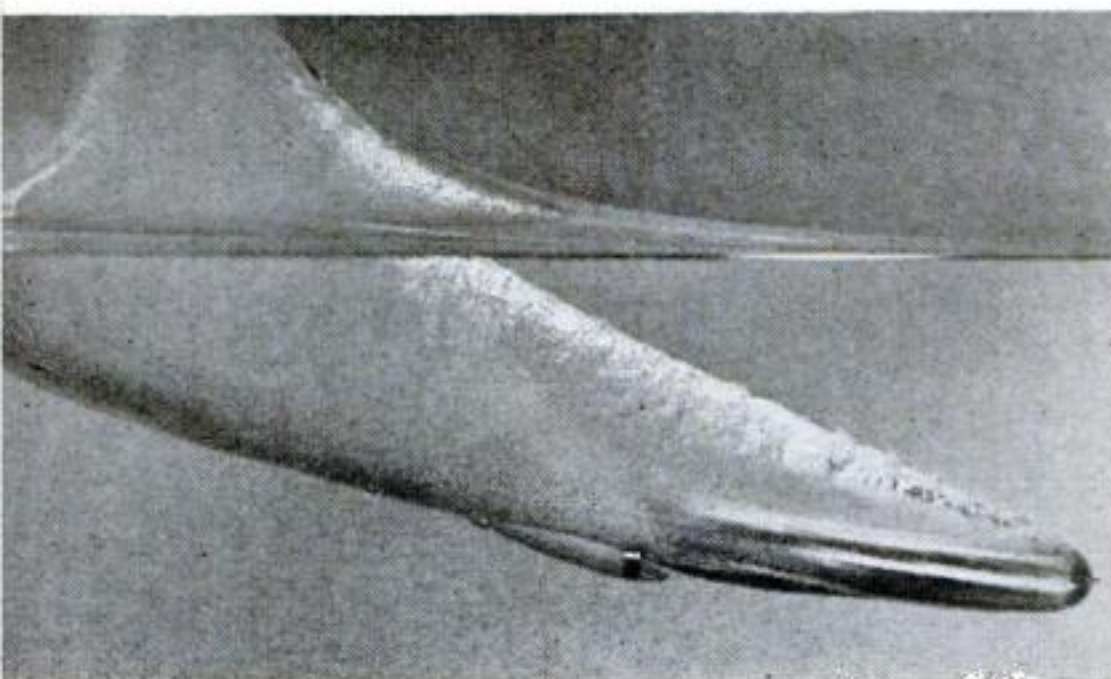
With data gained from the miniatures'



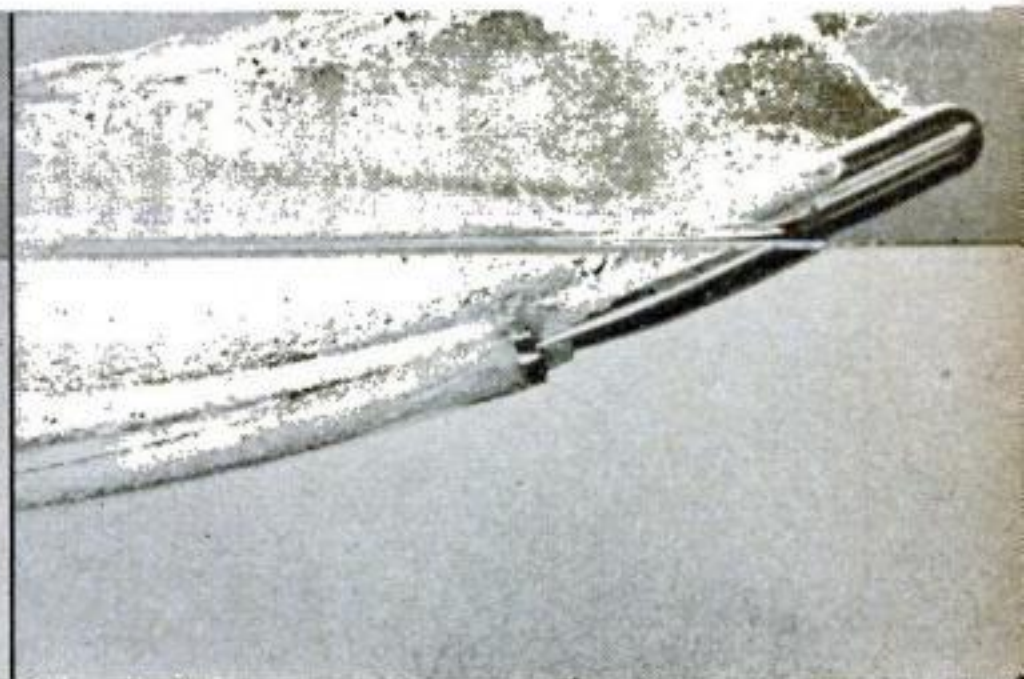
Firing miniature torpedoes instead of arrows, this crossbow mechanism is mounted over tank. Model, ready for firing, is in center channel, at apex of bowstring's shallow, inverted V.



With an oversize splash, the model is driven into water when crossbow is tripped. Cameras around tank record behavior of each model, producing picture sequences like that below.



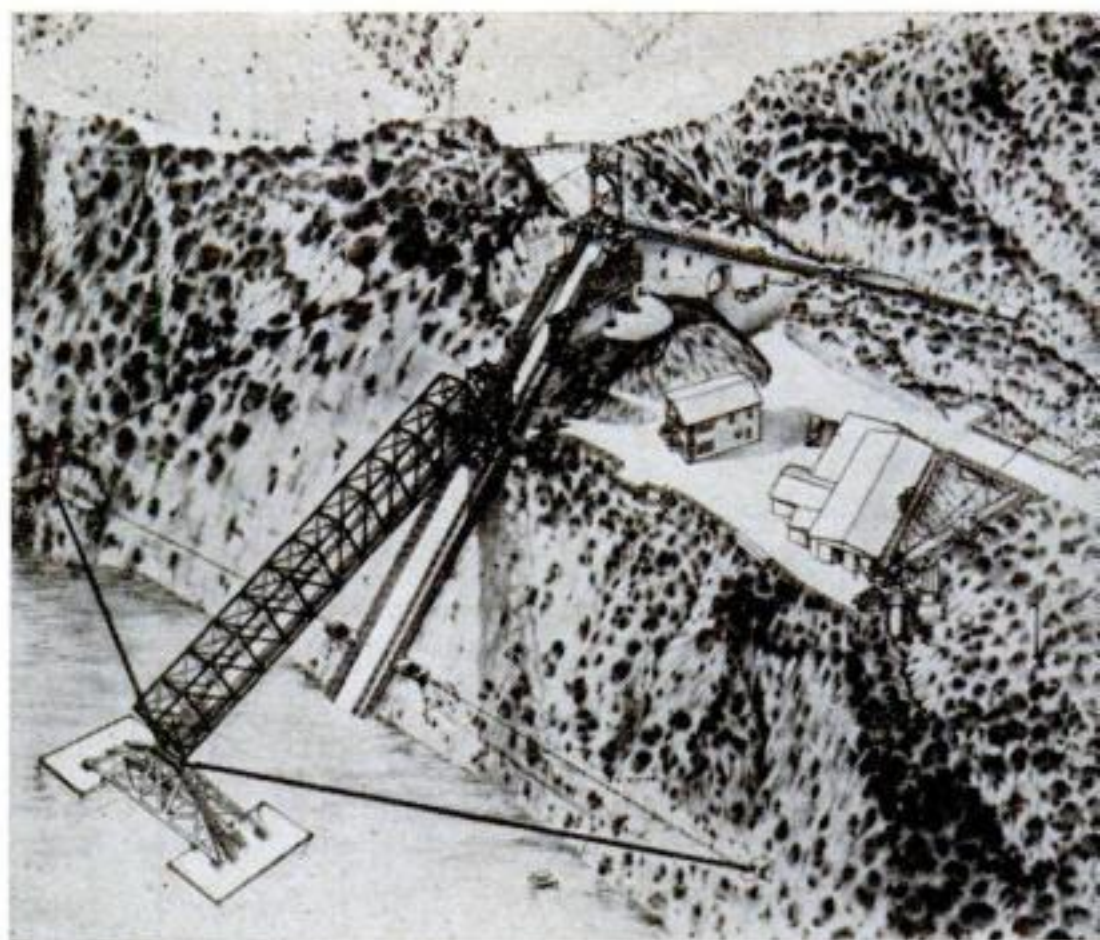
Angle changes as model continues its course through the tank. The nose rises gradually,



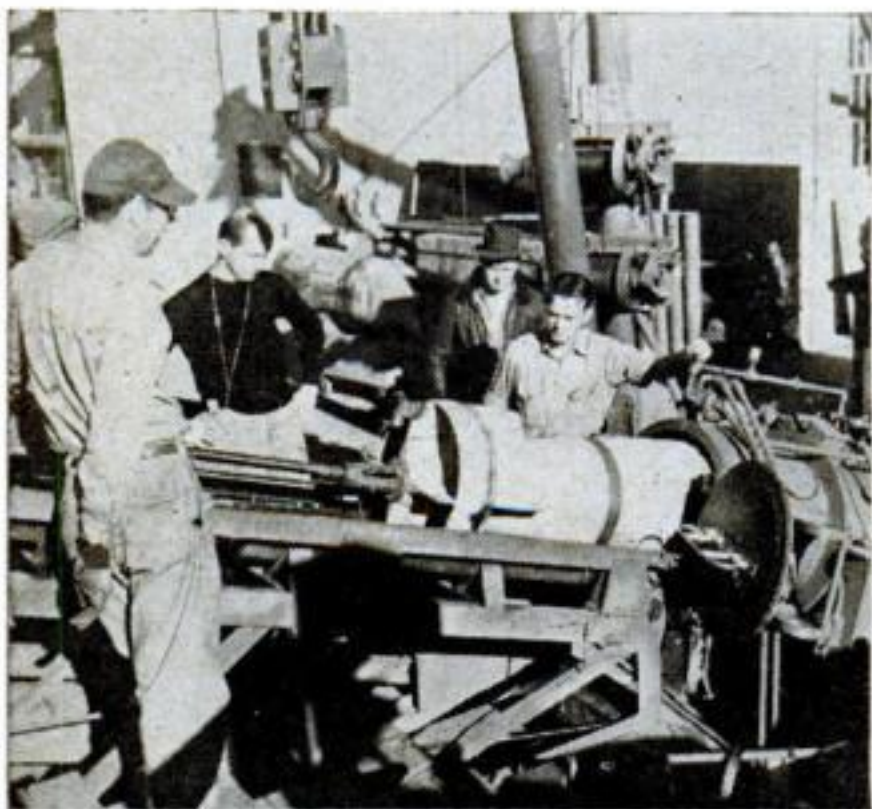
then gets too high—and model breaks water like a playful dolphin at the end of its run.

behavior, technicians of the Underwater Ordnance Test Range go to work with the "pea shooter"—a compressed-air, fixed-angle launcher. Its 300-foot tube sends full-size torpedoes smashing down a hillside into the lake at speeds rivaling the terrific pace of actual aerial launchings. As with the miniatures, cameras record every test—more than 3,000 since 1943—to catch any inaccuracy or any failure under the tremendous launching impact.

In addition to the fixed-angle system, a variable-angle launcher is now under construction. A multi-tube affair, it will allow test crews to fire torpedoes at angles up to 40° . Sliding up and down on concrete ramps, it will simulate conditions of actual air launchings for more detailed research. END



The 300-foot launcher will slide up or down ramps to vary firing angle, while barges at lower end move in and out from shore. Trestle will be largest all-welded structure in U. S.



Full-size torpedo is rammed into breech of the fixed-angle launcher by hand. Once breech is closed, compressed air is fed through maze of tubes to drive missile down hill into lake.



Shaped like a Christmas tree, a pillar of water spouts from lake's surface as one of the big jobs hits the firing range. Picture was taken from directly below the launching tube.



Business end of launcher is suspended over the shore of eight-mile-long lake in Sierra Madre range. Emerging from it, torpedoes hit water as they would if dropped by a plane.



Rubber-covered from head to toe, an RAF guinea pig, testing the new inflatable exposure suit, reclines in the water in relative comfort. Upper photo at left shows how the suit rolls up

into a "sausage" and fits under the collar of the "Mae West." Lower photo illustrates the ease with which it can be donned even in the cramped quarters of an RAF inflatable dinghy.

Sea Suit Fits Flier's Pocket

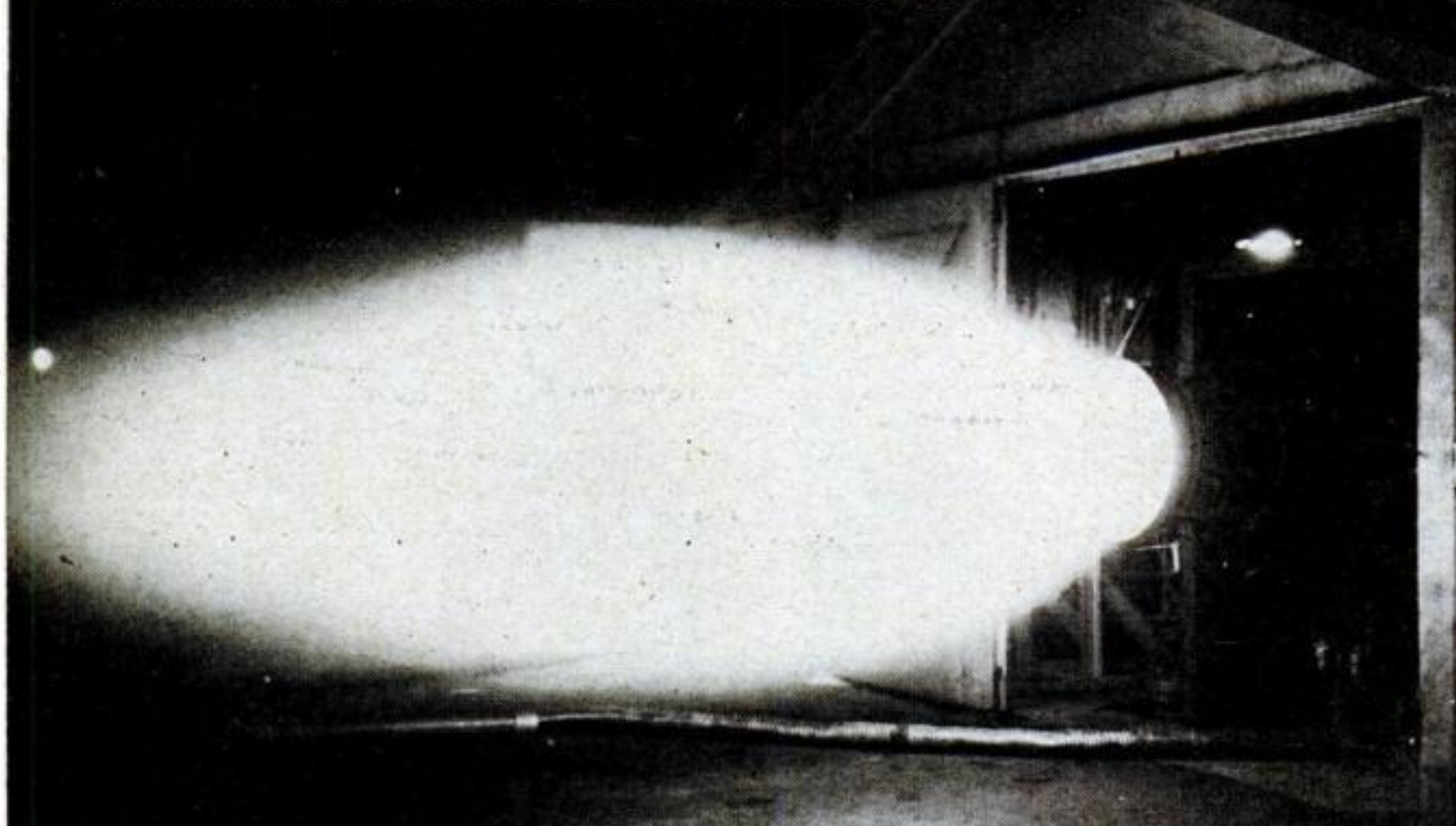
GOOD things come in small packages—at least for British aircrews downed at sea. A lightweight, inflatable suit that can be rolled up and pocketed under the collar of a "Mae West," is the latest effort of the RAF to protect its fliers against exposure in forced landings and crashes at sea.

Consisting of two layers of rubber with air space between, the one-piece suit not only helps keep the wearer afloat but provides air insulation against the cold and damp of icy waters. Folded, it weighs only 2 pounds 12¼ ounces. It is inflated by the wearer after being put on. Now undergoing tests at Farnborough, England, it may become standard equipment for RAF crews.

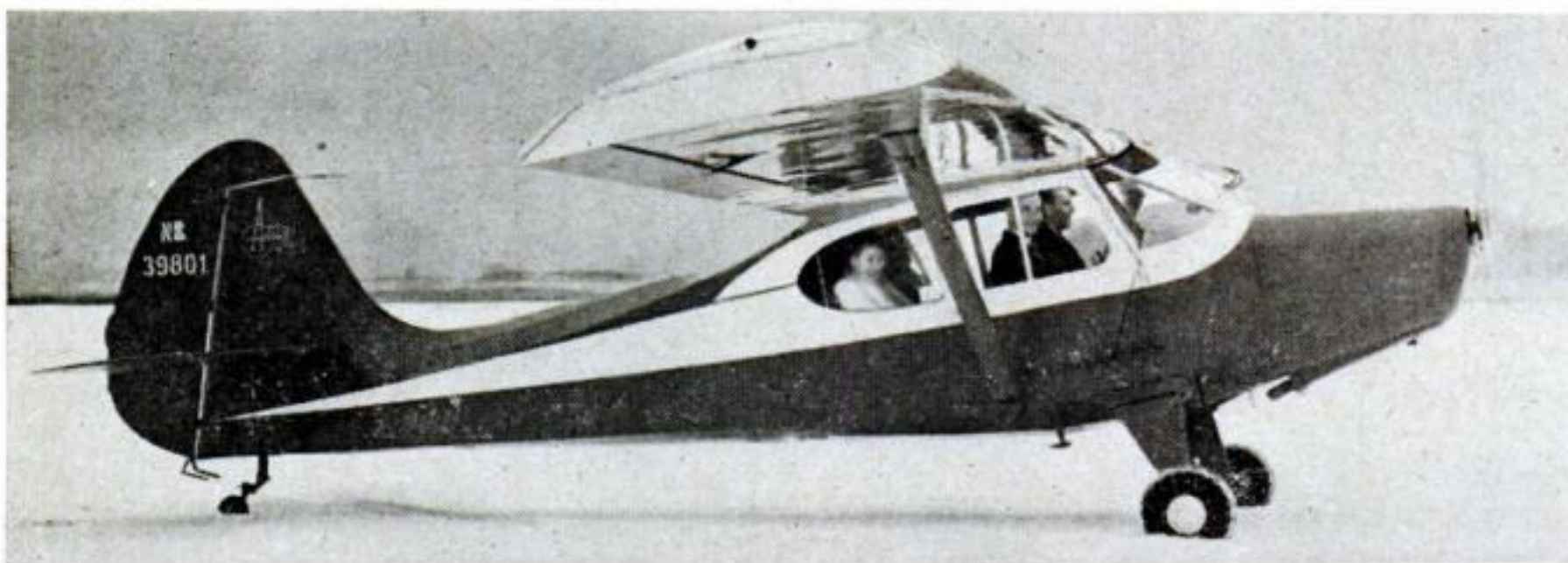
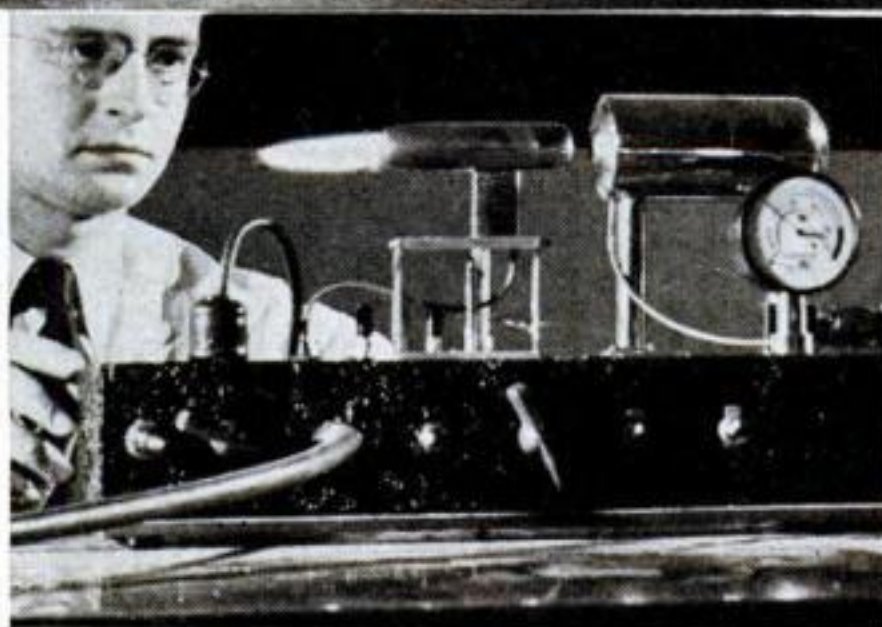


Roomy and flexible, though it makes you look like a rubber mattress, the suit allows free movement, as wearer shows by carrying rubber dinghy.

What's New in Aviation



Building Better Jets. The fiery blast shown above is invisible to the naked eye, but infrared film shows what a turbojet afterburner (PS, Oct. '47, p. 82) looks like in action. In this GE test unit, fuel is injected into the tailpipe of a TG-180 to boost its thrust. At right is a less imposing but equally important aspect of jet research: a baby ramjet in the Westinghouse laboratory, spouting its tiny flame in a compressed-air stream—simulating a 375-m.p.h. pace—to help engineers improve jet engines.



Aeronca for Four. New entry in the lightplane field (where new entries have been scarce lately) is the four-passenger Aeronca Sedan. It has a 145-hp. Conti-

nental engine and a top speed of 120 m.p.h. Equipment includes complete night lighting facilities, with twin landing lights (one for glide path, one for taxiing) in the wing.



Hoppicopter Sprouts Wheels.

The first one-man helicopter built by Horace Pentecost, of Seattle, was a back-pack affair with no landing gear (PS, July '45, p. 68). His latest version (above), now making brief test hops, has tripod gear and even provides a seat for the pilot. The 'copter has a 35-horsepower engine.



Wing Sling Speeds Repairs.

A homemade sling devised by a metalsmith at Quonset Point (R. I.) Naval Air Station has outmoded the get-10-men-and-heave method of changing plane wings. Attached to a crane and adjusted to a wing's center of gravity, it allows two men to handle small wings; four men, the big ones.

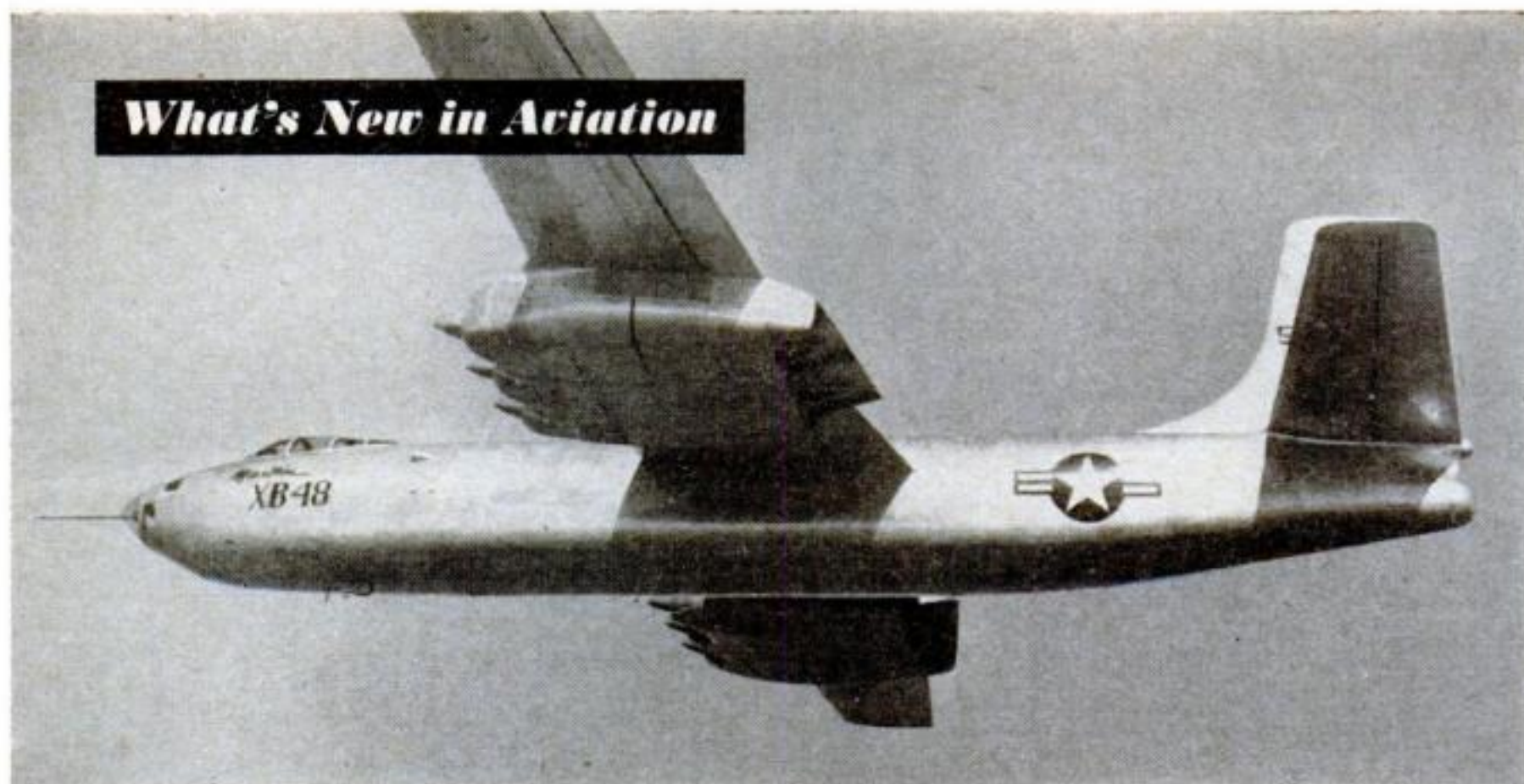


Paper Helps Seal Runways. By rolling a paper-cord filler into runway expansion joints, this device permits the use of new sealing compounds that outdo asphalt.



Playing It Safe. Reports that radar can set 'off flashbulbs under certain conditions resulted in this canister for air shipment. Metal walls reflect radar waves.

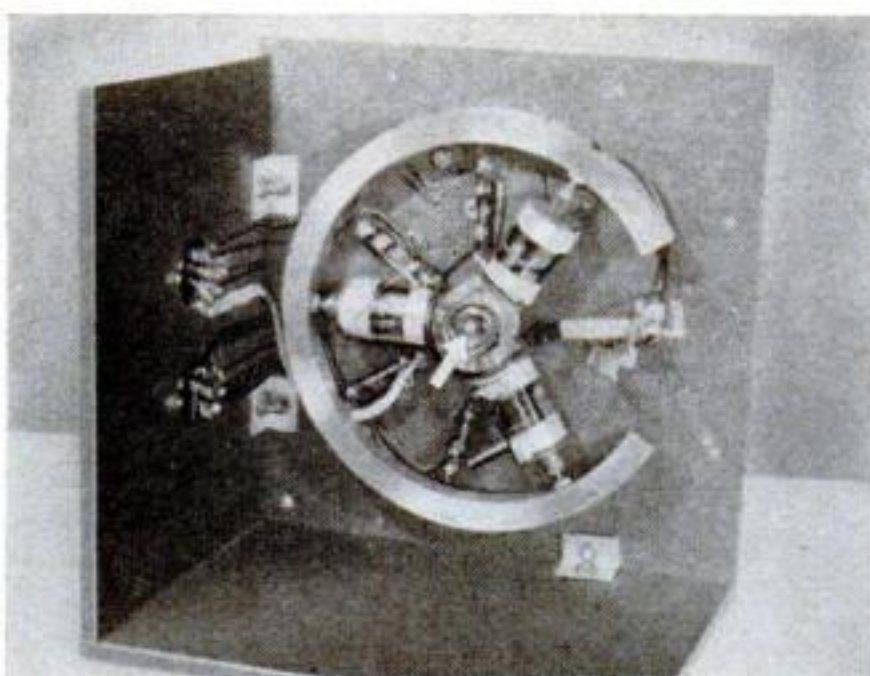
What's New in Aviation



XB-48 Moves Upstairs. Entering the high-altitude phase of its intensive flight-test program, the six-jet Martin XB-48 posed for this aerial portrait over Chesapeake Bay.

The second of the big bombers (whose box-mounted engines turn out a total of 24,000 pounds' thrust to lug a 10-ton bomb load) is nearing completion.

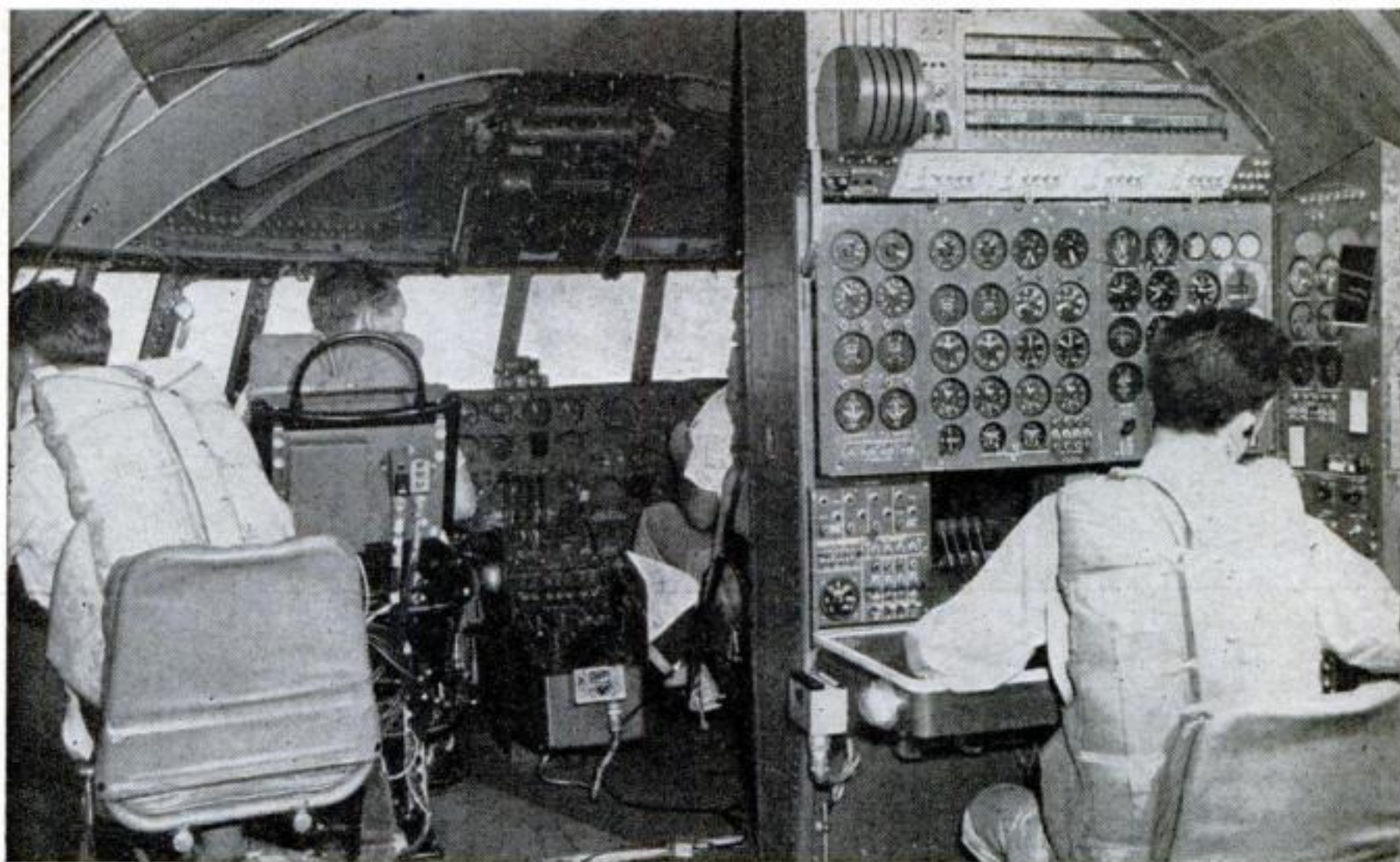
Super Top Tests Paint. To test adhesive qualities of paint for high-speed aircraft, Navy researchers spin a quarter-inch steel ball (arrow) up to 2,400,000 r.p.m. in the ultracentrifuge at right. A dot of paint is put on the ball, which is then magnetically suspended in a vacuum and driven by a rotating magnetic field. Speed is increased until centrifugal force rips off the paint; at top speed, the ball's surface travels about 1,800 m.p.h. Top of ball is flattened to keep it on a constant axis, and it's so friction-free that it will go on spinning for a week after the power is cut off.



Mountain-Top Icing Lab. In frigid gales atop Mt. Washington, N. H., Navy technicians have been learning about icing hazards for jet planes. A McDonnell Phantom, visible at left, above, was trucked up the peak and housed in a hangar built to



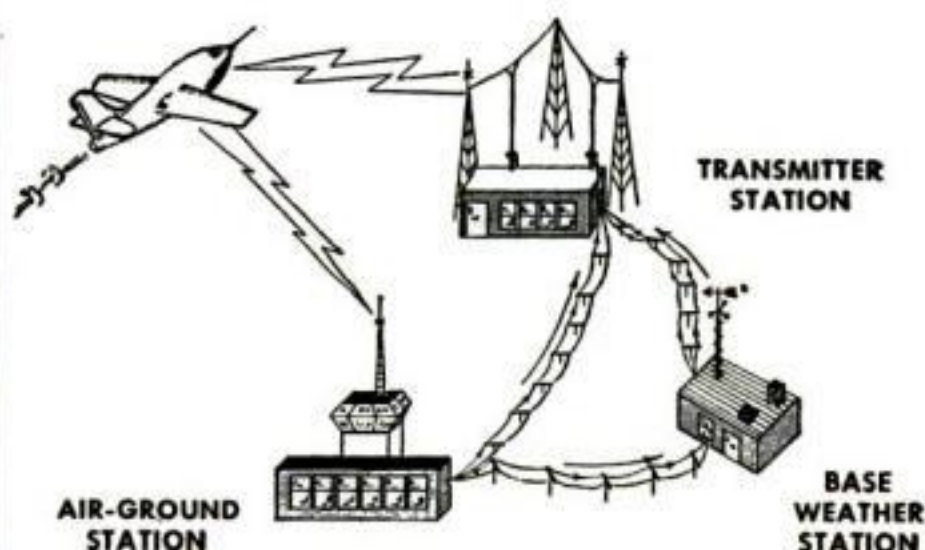
stand 200-m.p.h. winds and heavy snow like that pictured on the right. In winter-long tests, research crews found that ice forming on intake vanes can cut off a jet engine's air supply. As a result, new anti-icing systems are now being developed.



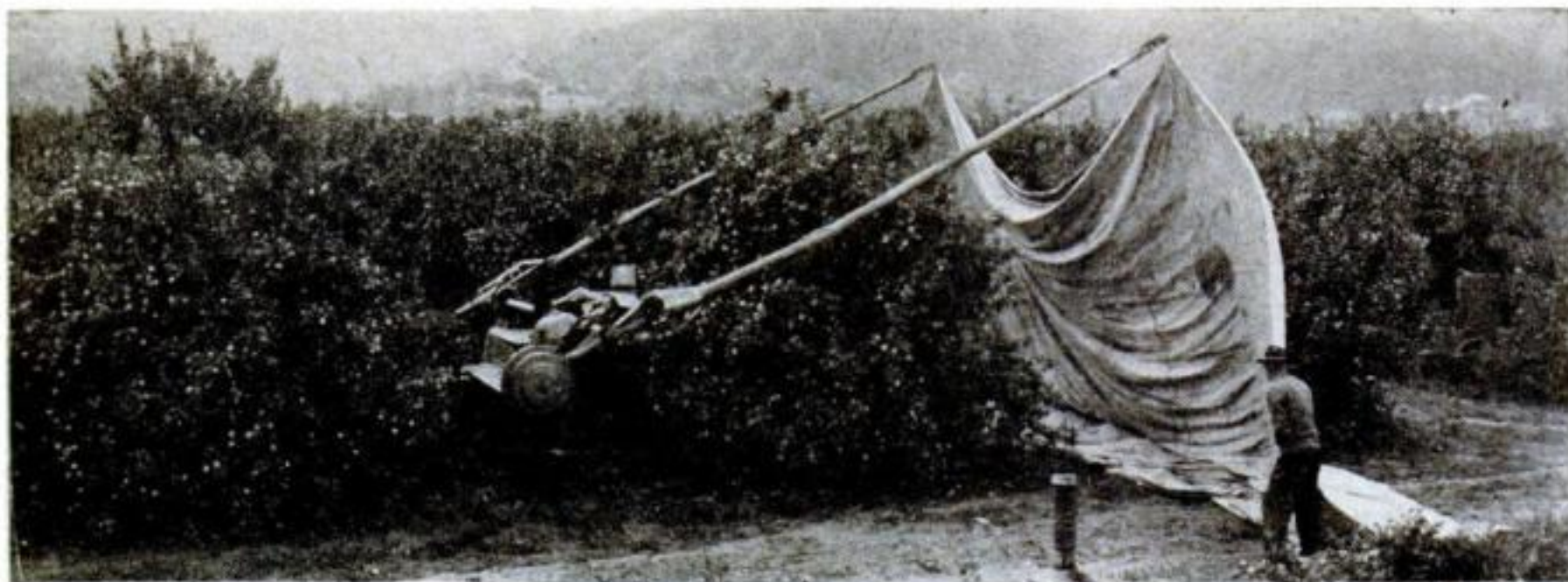
Constitution Close-Ups. Getting ready to go to work, the 180-passenger Constitution (PS, Nov. '46, p. 89) shows off its interior. View of the flight deck, above, shows how pilots and flight engineer (in right foreground) share the work of flying the Navy's biggest transport. Engineer handles all engine controls except during landings and take-offs, and an assistant takes care of electrical controls. At right is the rear part of the transport's spacious upper deck. Spiral stairway leads to lower deck, which can be used for either passengers or cargo. Four 3,500-hp. Wasp Major engines power the big air liner.



Weather Won't Wait. And neither will high-speed, fuel-gulping jet planes, which can't stand by aloft while a weather forecast goes through a time-killing series of relay operations. So the U. S. Air Force has developed a radio-telephone system that

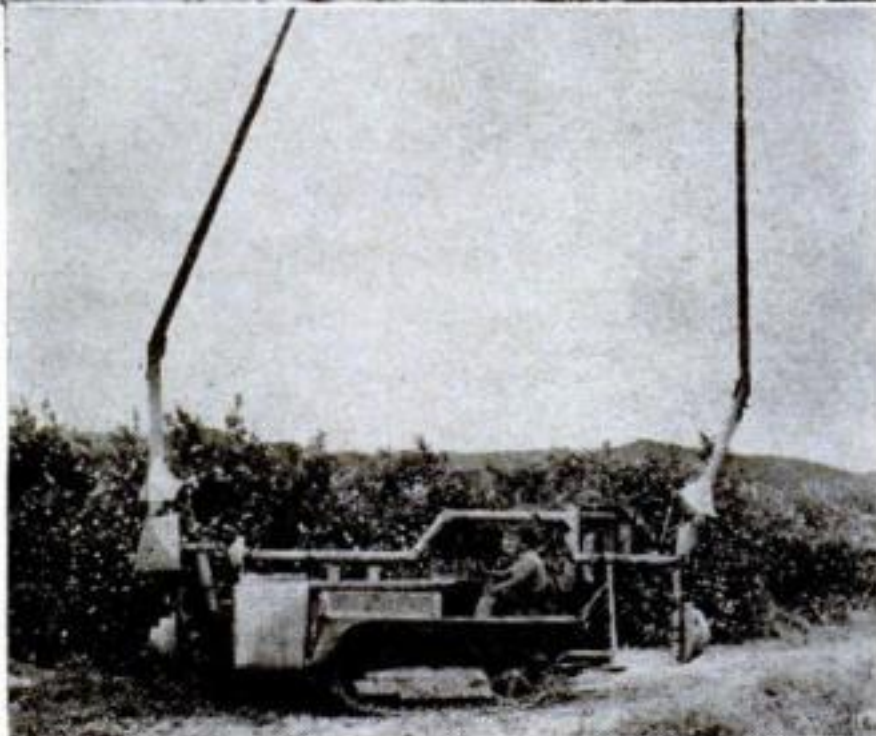


puts jet pilots in direct contact with weather forecasters. As illustrated in the drawing, above, the system hooks a weather station into the normal air-to-ground radio network when a forecast is required. It is being tested at three Air Force bases.



Trees Covered Quickly

CALIFORNIA fruit growers have mechanized the tedious job of spreading canvas fumigating tents over trees. Twin tubular-steel arms are attached to the ends of a tractor, as shown at right. The arms are lowered around a tree by a gear arrangement, and the canvas is hitched on. The arms are then raised, pulling the canvas over the branches in a single operation, as shown above. One tent puller can cover 100 trees an hour. Another type, mounted on a truck, has arms joined in a wide curve and moved by gears attached to the piston of an hydraulic cylinder.

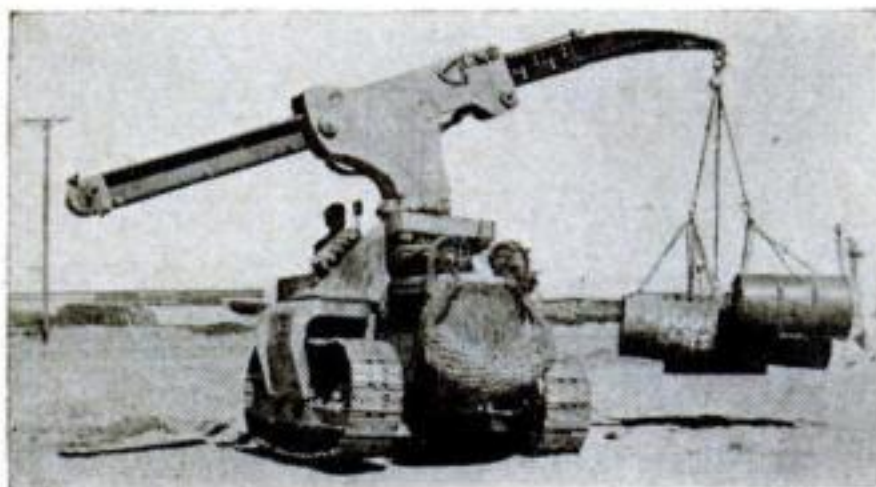


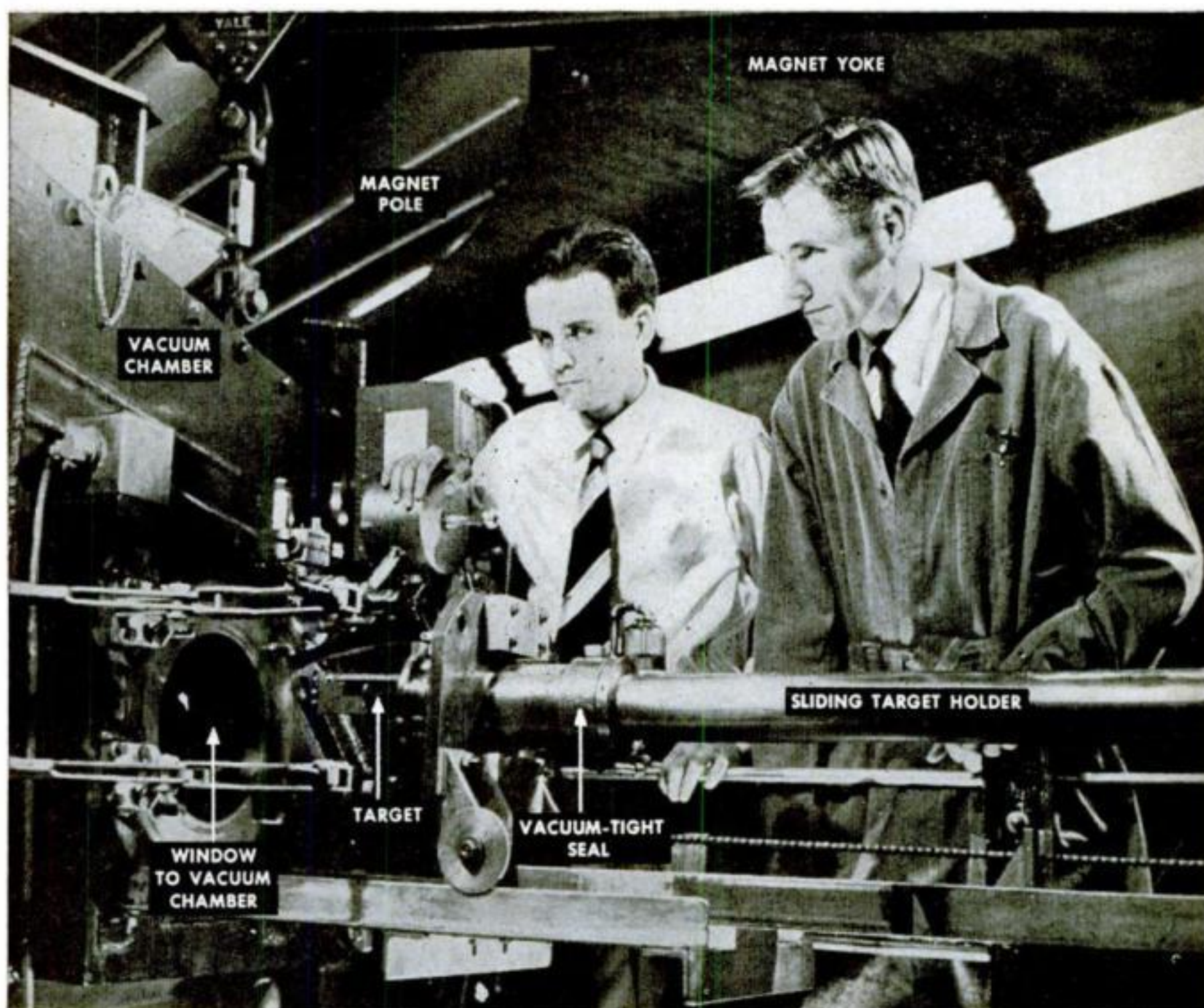
Rig in a Blanket

WHEN clanking machinery kept the neighbors awake, the General Petroleum Corp., of Los Angeles, wrapped this derrick (right) in a blanket of rock wool. It cut the noise to one-fifth. Insulation is in a series of horizontal panels covering the rig.

Aids Beach Loading

THE combination crane-tractor shown below is designed to help Seabees load and unload cargoes on sandy beaches. The movable arm picks up heavy loads and deposits them 20 or more feet away. It is made by Austin Western Co., Aurora, Ill.





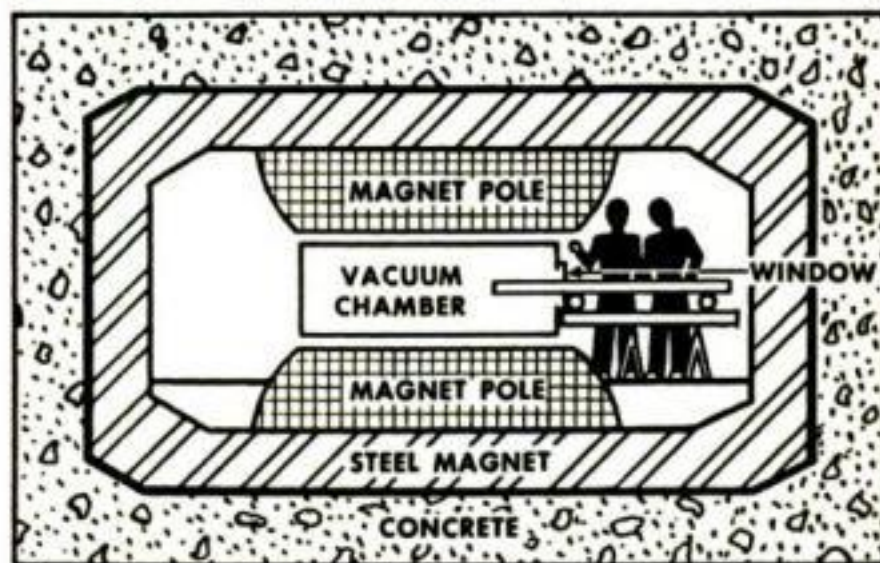
Drs. Lattes (left) and Gardner set the target before placing it inside cyclotron. These two young physicists created the first man-made meson after many previous attempts had failed.

Man Makes Matter

MATTER has been made out of pure energy in a cyclotron by two young scientists at the University of California. They fired 380,000,000-electron-volt alpha particles (the hearts of helium atoms) at targets of copper, carbon, and beryllium. After the collision, new invisible particles appeared inside the cyclotron.

These particles got their weight, 313 times that of an electron, from the speed energy of the protons in the "bullet." Where before there had been one fast and one slow particle, there were now three particles weighing more than the two original ones.

These particles are mesons, found previously in cosmic rays. Mesons may be the clue to many mysteries, such as nuclear bind-



Sketch above shows how scientists in top photo are standing actually inside part of cyclotron. They are next to vacuum chamber, with magnet yoke visible behind them and pole at upper left.

ing energies. These strange, gravity-like forces, which hold the atomic nucleus together, are tremendous (PS, Jan. '48, p.113). If they can be released profitably they will make today's uranium pile look like Watt's original steam engine.

The mesons were produced by Dr. Cesare M. G. Lattes, of the University of Sao Paulo, Brazil, and Dr. Eugene Gardner, researcher in California's Berkeley Radiation Lab.



Wide, low-pressure tires spread weight over a large area, help JBC navigate mud or swamps.

Jungle Buggy Packs a Load

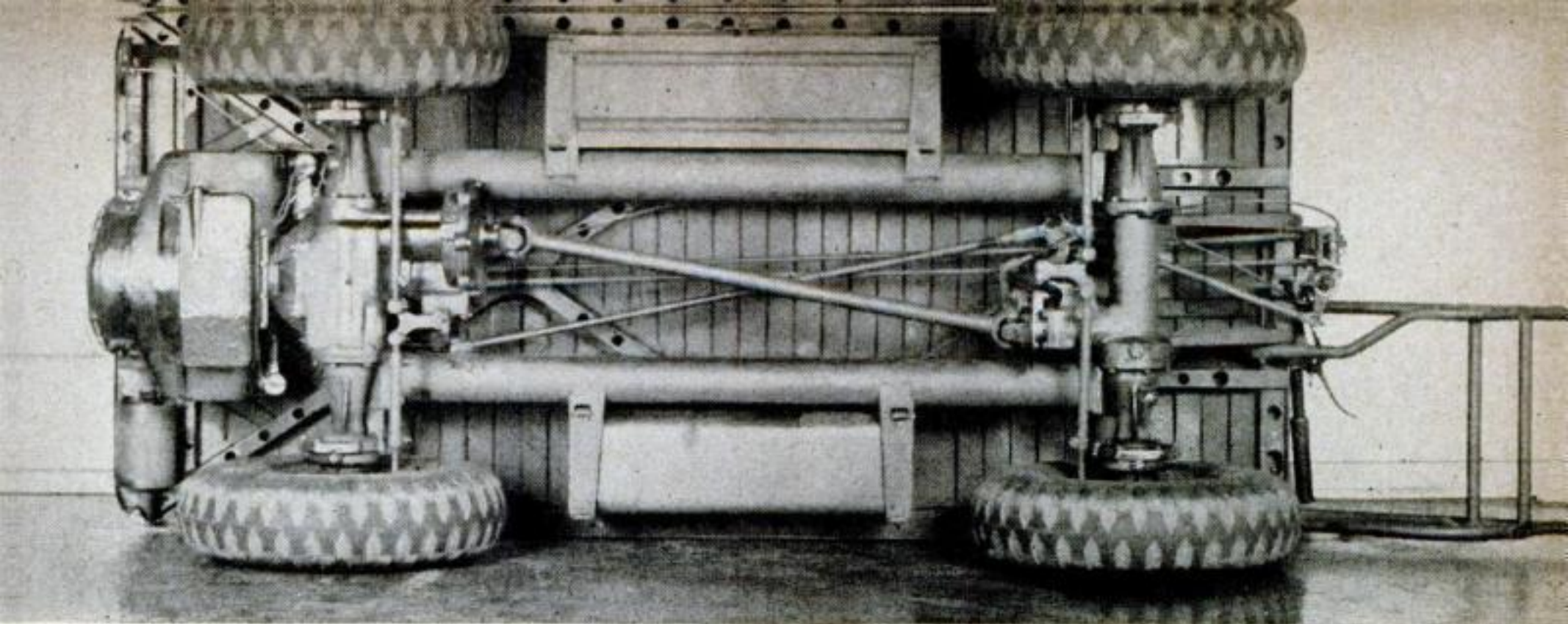
A PINT-SIZE jungle buggy, as versatile as it is small, is the latest addition to the motorized equipment of U.S. armed forces. Known as the JBC (Jungle Burden Carrier), it can carry half again as much as its own weight, and can go places that might drive a mule mad.

Designed by Willys-Overland, this baby brother of the Jeep was originally planned as a litter carrier near the end of World War II. Field tests at Eglin Field, Fla., however, proved it equally valuable for carrying supplies and men over rough ground. Four-wheel drive, four-wheel brakes, and four-wheel steering, plus a tricky tiller arrangement, allow it to get around with ease whether roads exist or not.

Powered by a nine-horsepower, two-cylinder engine, the JBC is a mobile platform standing about two feet high. Fully fueled,

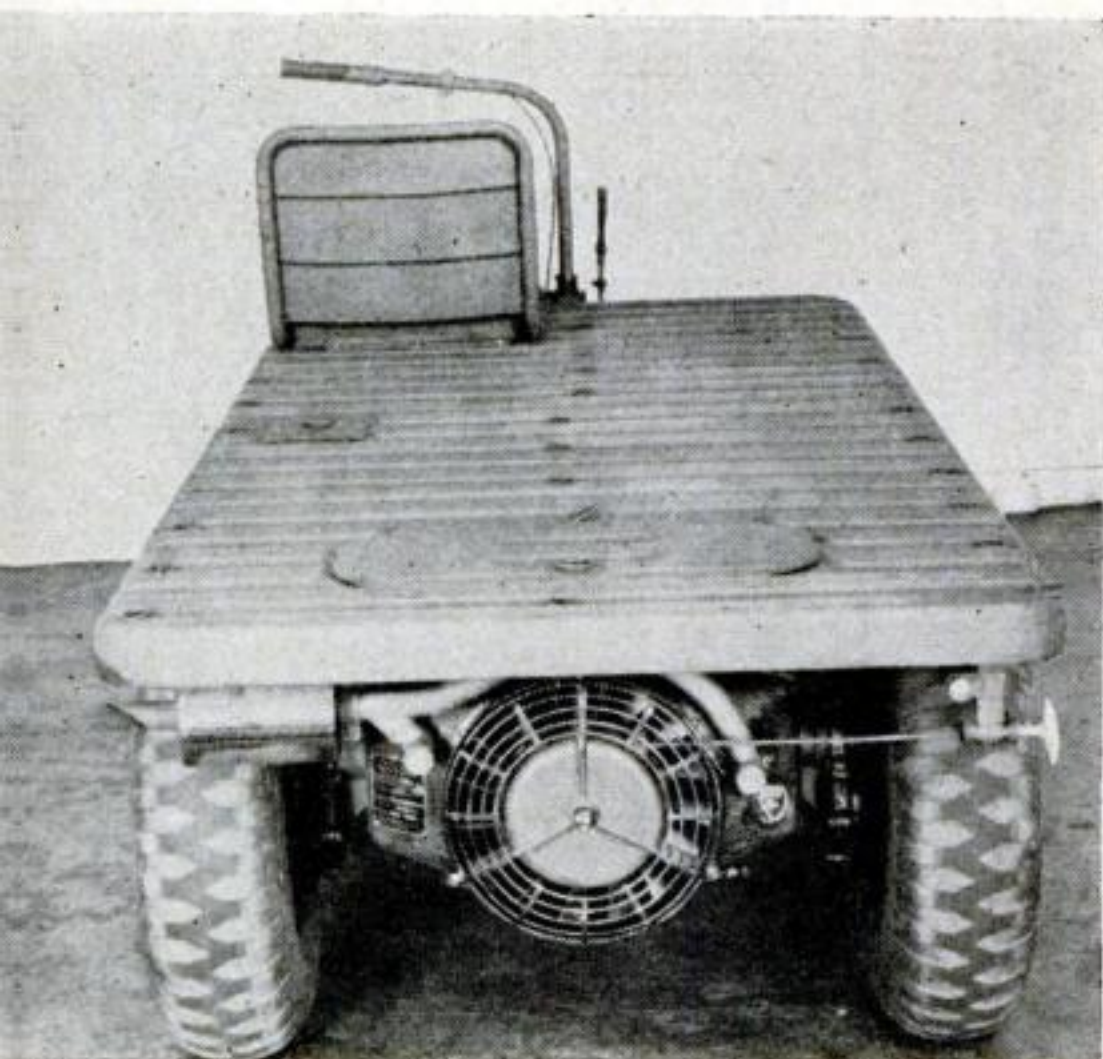
it weighs only 550 pounds and can carry a useful load of 800 pounds. With three speeds forward and one reverse, it climbs 43 percent grades in low gear and does about 27 m.p.h. in high. Tires are 6.50 x 10 and carry only 7½ pounds' pressure, giving the JBC good footing for soft going. Its turning radius is only 9½ feet.

The driver of a JBC has a novel choice: he can ride in the single seat or he can walk, as his fancy or the terrain dictates. The steering tiller has a motorcycle-type accelerator in its handle and can be swung through a 180° arc. By setting it in one of four positions, the driver can leave his seat and walk on either side of the vehicle, in front of it, or behind it when it's in reverse. A hand brake beside the tiller guards against the JBC's running away and leaving its pedestrian driver.



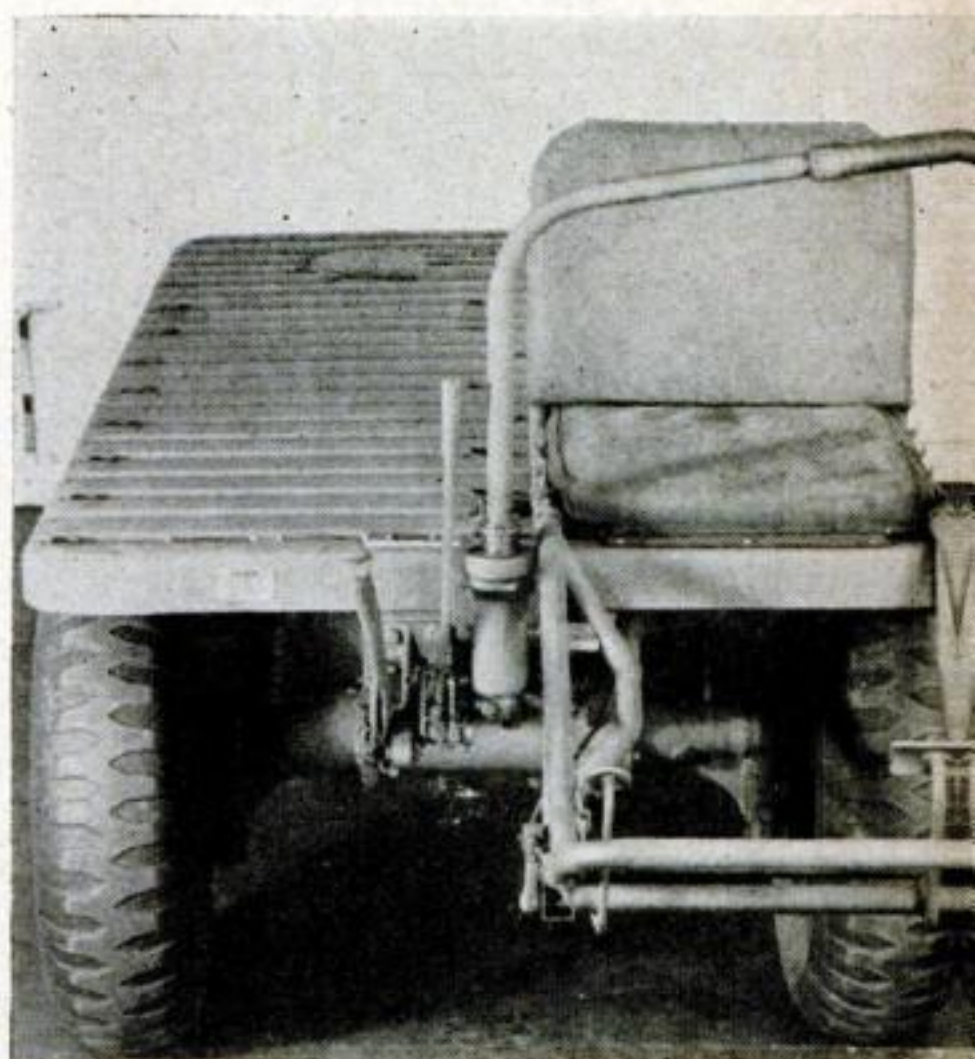
All four wheels have steering knuckles, and front and rear tie rods are interconnected. Since wheels are small, drive shaft to front wheels is

offset upwards to increase clearance. Wheelbase is 54 inches, tread $31\frac{1}{2}$ inches. Not counting the footrest, length of the JBC is 85 inches.



Rear-mounted engine is air-cooled, its two cylinders horizontally opposed. Handle at right is starter cable, like those on outboard motors.

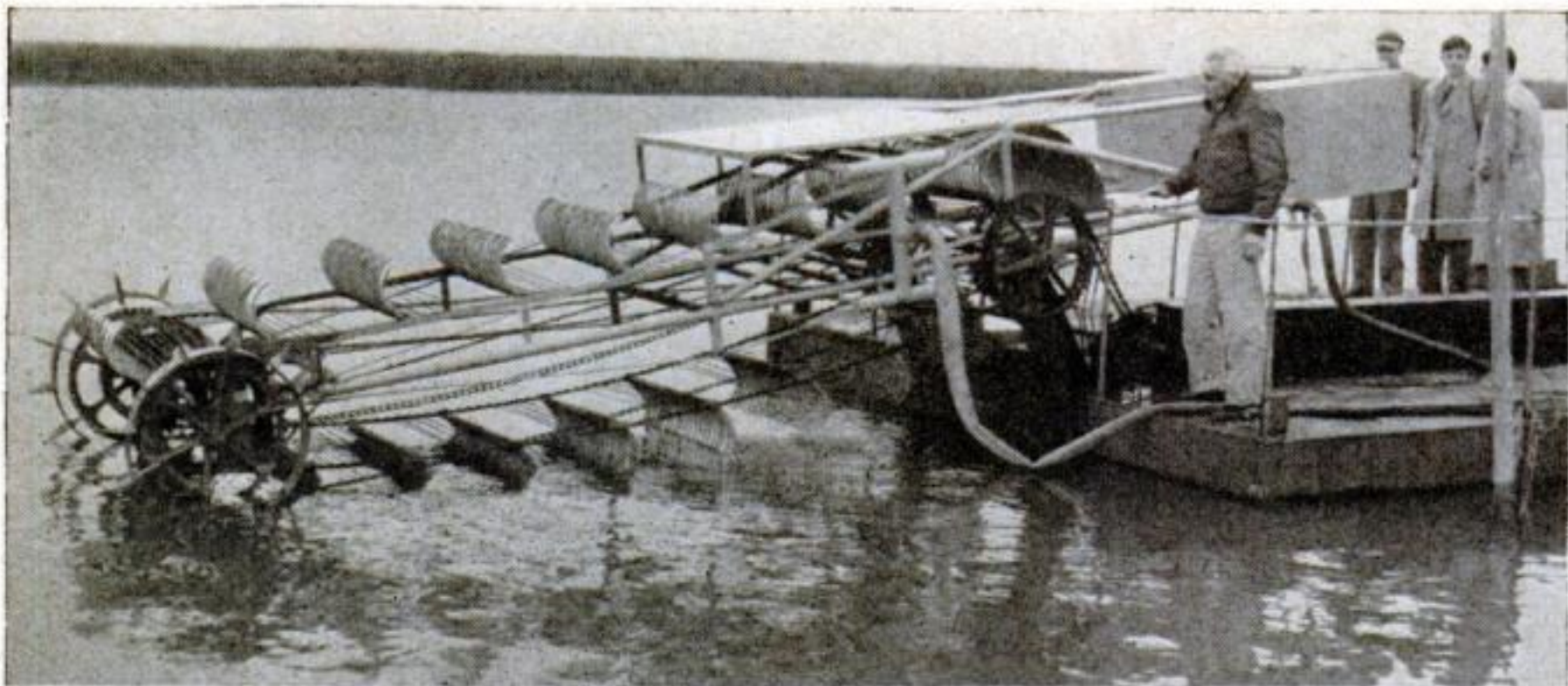
Load is tied down to the bed with straps that buckle into metal loops. Here, using reverse gear with tiller swung out, driver steers the



Hand brake, gearshift, and tiller adjoin driver's seat. JBC has foot brake, and a foot throttle besides hand accelerator on the tiller.

vehicle up a hill from behind. This lightens the load and, under fire, would keep driver from being a sitting duck on exposed seat.





Filling counterbalance tank above barge's hull raises harvester's chain-driven conveyer belt and twin tractor wheels for shallow-draft work.

Wheels turn one way to pull barge forward, and belt turns the other way, so prongs scrape along bottom in the direction barge is moving.

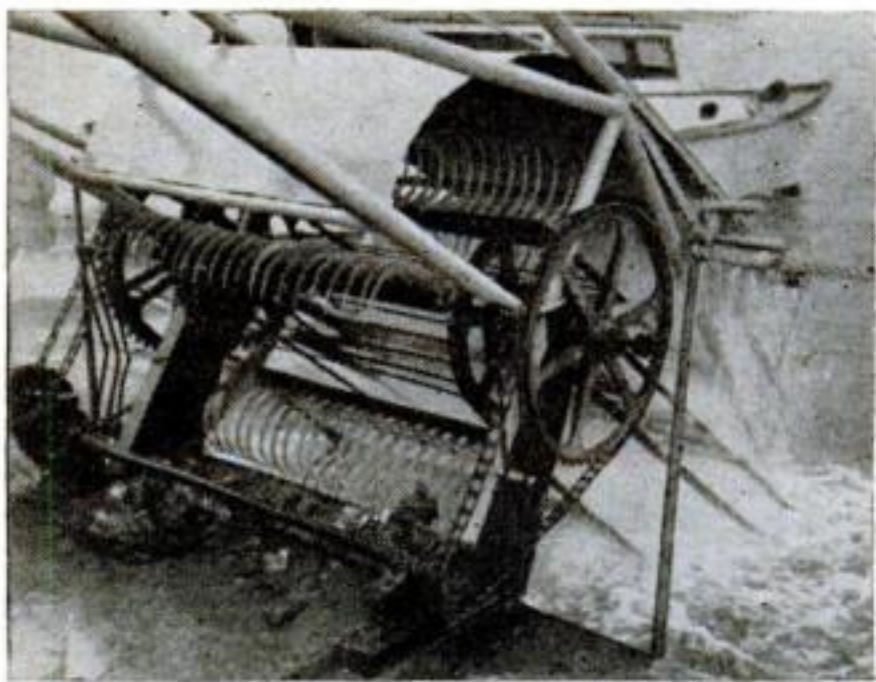
The Oyster Hoister's Here

PLOWING through Louisiana bayous like a seagoing hay rake, a mechanical fisherman has added something new to the oyster industry. It is an automatic harvester—instantly known as the "Oyster Hoister"—that can prong maybe 100 bushels of oysters an hour.

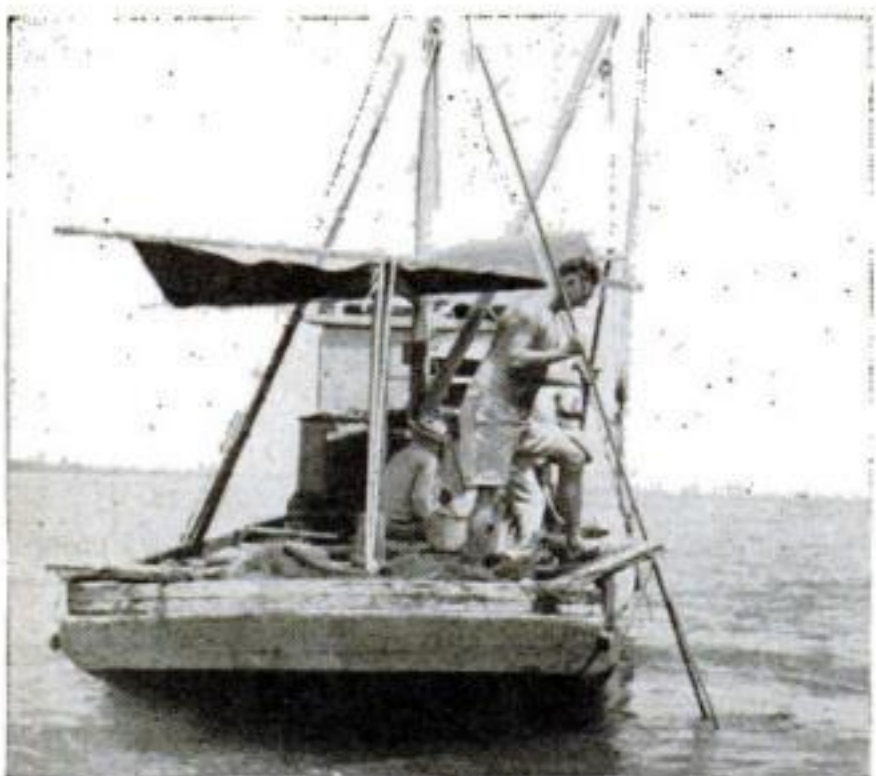
The contraption consists of a counterbalanced conveyer belt fitted with rows of curved steel prongs and mounted on the bow of a shallow-draft barge. An engine in the center of the craft drives the belt and provides power for the harvester to pull itself along the bottom by means of toothed tractor wheels at the lower end of the conveyer.

The main engine also supplies water for the counterbalance tank and operates a centrifugal pump that cleans incoming oysters with high-pressure water jets. A smaller engine at the rear of the barge drives a propeller when the harvester is idle.

The inventor of the machine, A. M. Brown, of Mobile, Ala., says it can replace 100 men using the time-honored but snail-pace method of picking oysters off the bottom with hand tongs. He rates it above automatic dredges, too, since the continuous motion of the rakes cultivates the bottom while scooping up oysters, leaving a bed ready for replanting. And an improvement is on the way that will even do replanting.



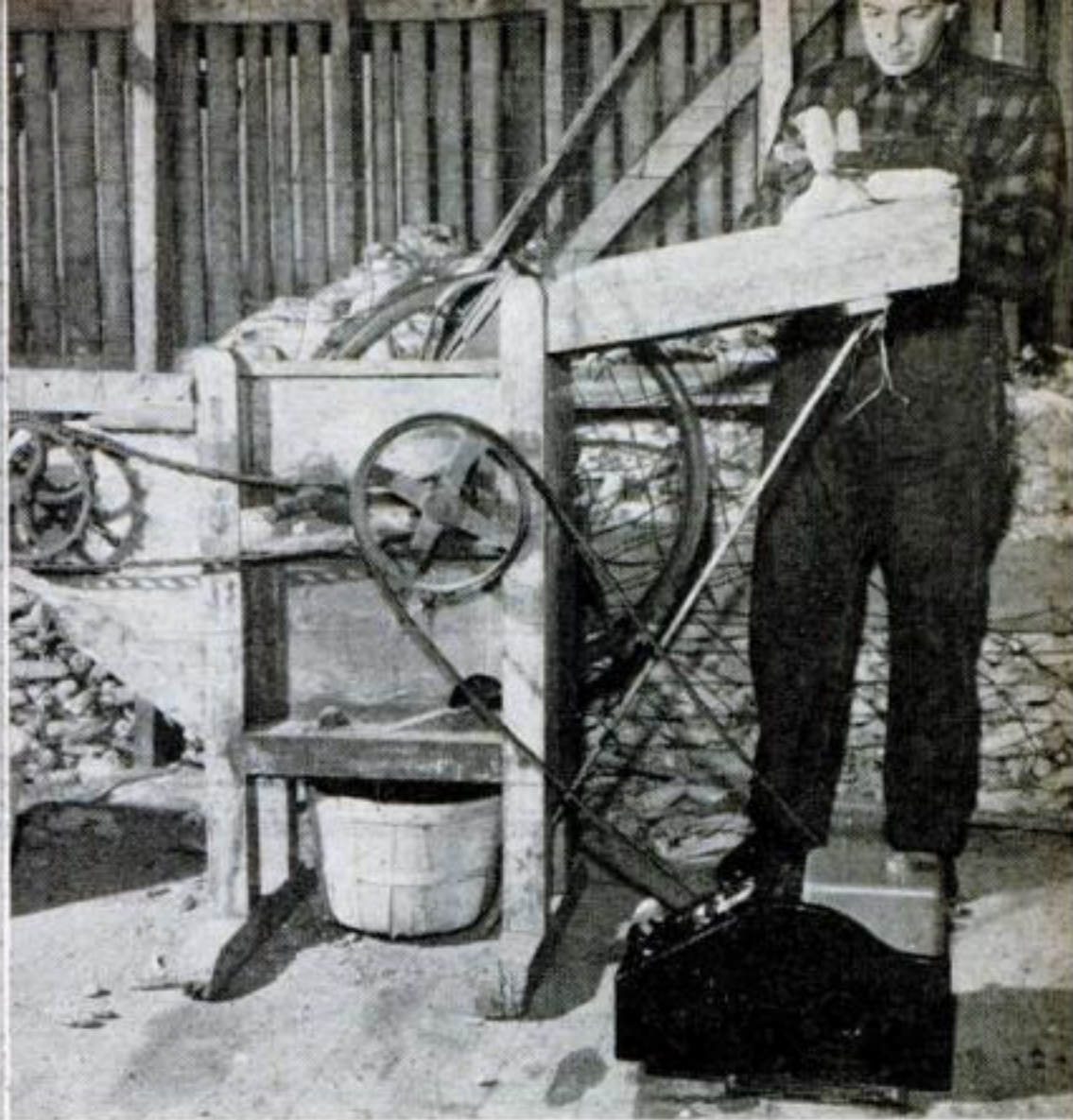
Swinging up over pivot point from deep-water position, prongs (and oysters, if any) pass through cleansing jets. Prongs are set about 1½ inches apart; belt has 19 rows of them.



Old-fashioned tongs may not match harvester's pace, but are still widely used. They resemble two long rakes with handles hinged to bring tines together and pinch oysters off bottom.



Light and compact, the Multi-Tool [®] power unit shown above has a hand hole at either end for easy carrying and lifting. Its half-gallon gas tank meets safety regulations for indoor use.

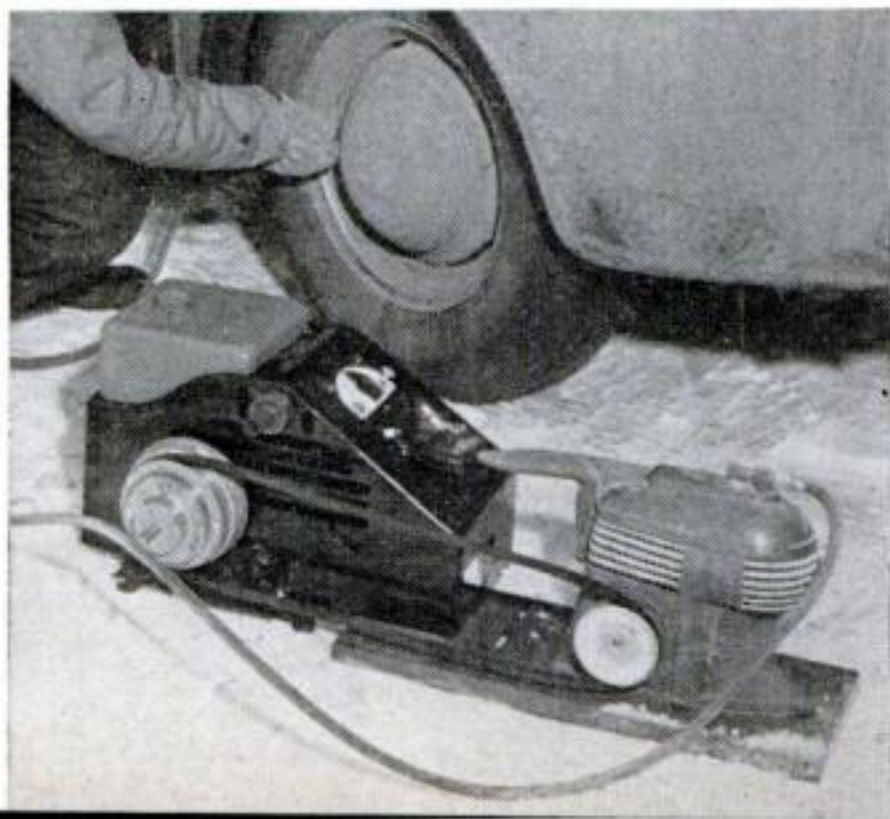


Here the unit is driving a corn sheller. Direct-drive speeds range from 1,600 to 2,600 r.p.m. Changing pulley ratio between power unit and driven unit gives a wider speed range.

Portable Power Parcel Is Jack-of-All-Trades

ON THE farm, on construction jobs, and in the home workshop, the new Multi-Tool [®] power unit adapts itself to a wide variety of chores. The heart of the versatile machine is a Continental 1½-hp., four-cycle, air-cooled engine. It has a handy dial for fingertip speed control, and an automatic governor provides constant speed under load.

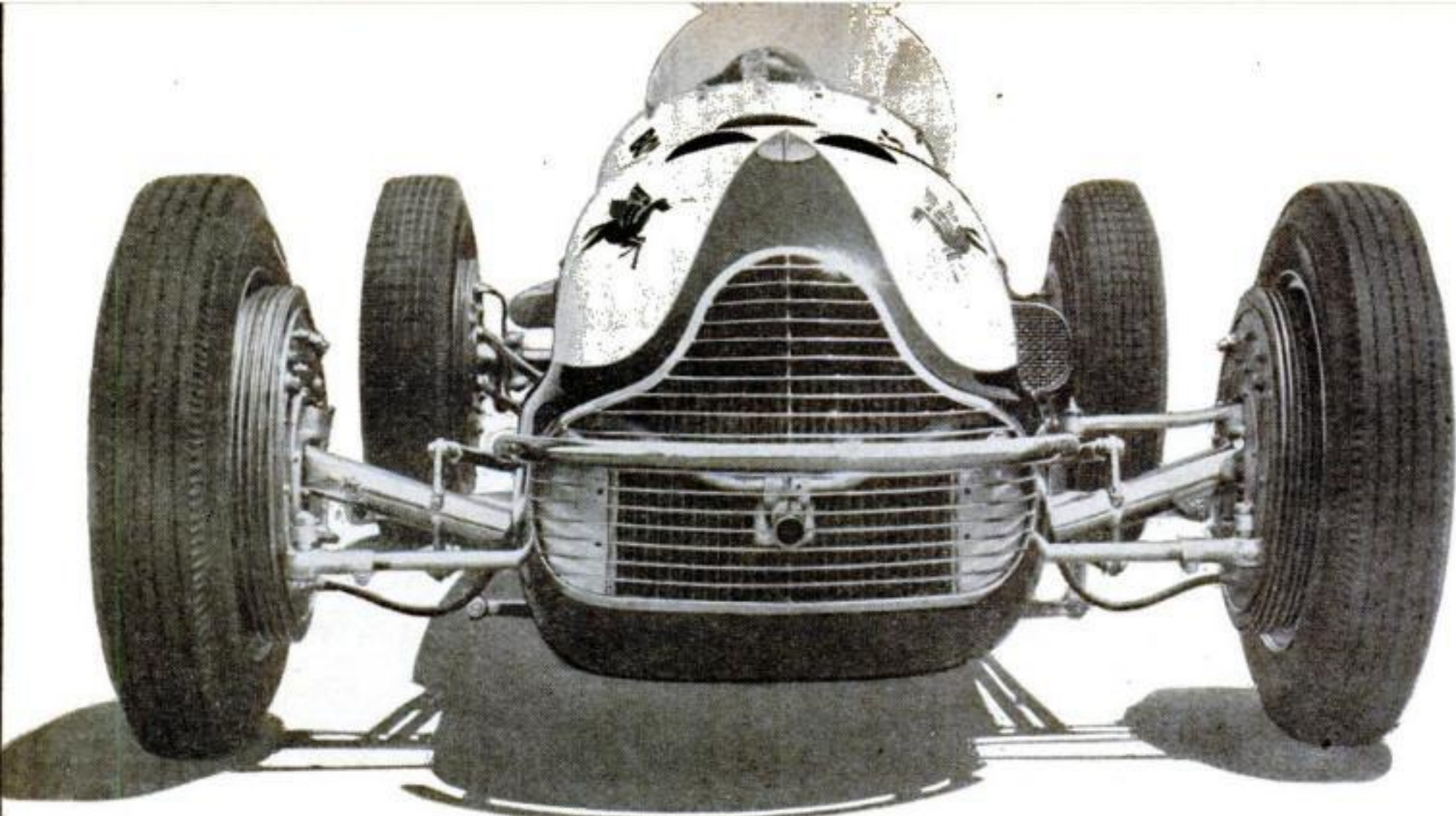
Coming to the scene of trouble, the portable power machine runs the compressor that inflates the flat tire, as shown in picture below. It also will drive generators and bench tools.



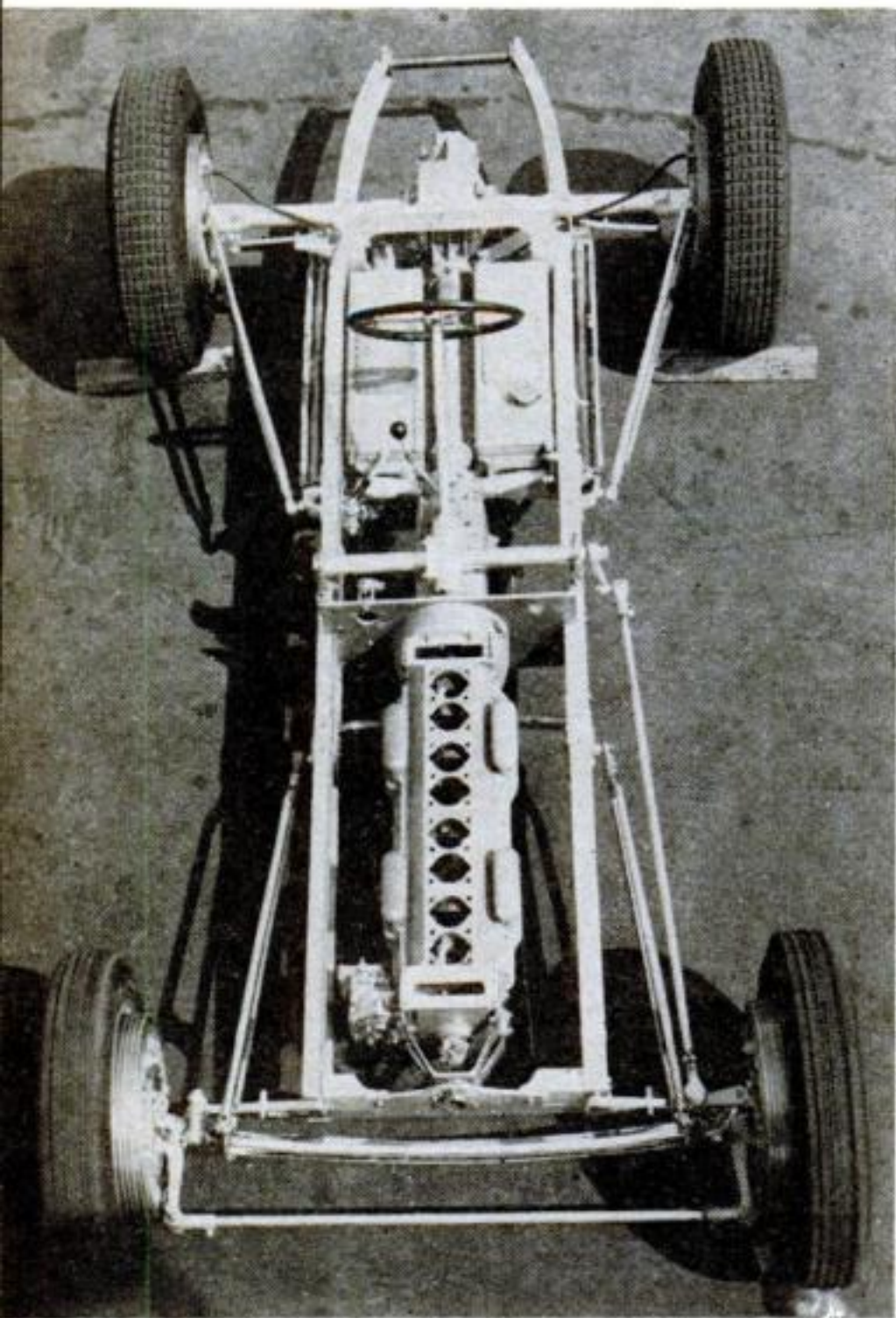
Accessories include a transmission enclosing an automatic clutch, a flexible shaft taking all standard tools, a sub-base for buffer and grinder, and an exhaust to pipe gases out of doors. The manufacturer, Continental Motors, stresses the unit's value as an auxiliary power source in areas where storms cause frequent current breakdowns.

With flexible drive shaft attached, the Multi-Tool [®] does a drilling job. It is equally adaptable for use as a buffer or grinder. The unit (on bench) is closed in a metal-sheet housing.

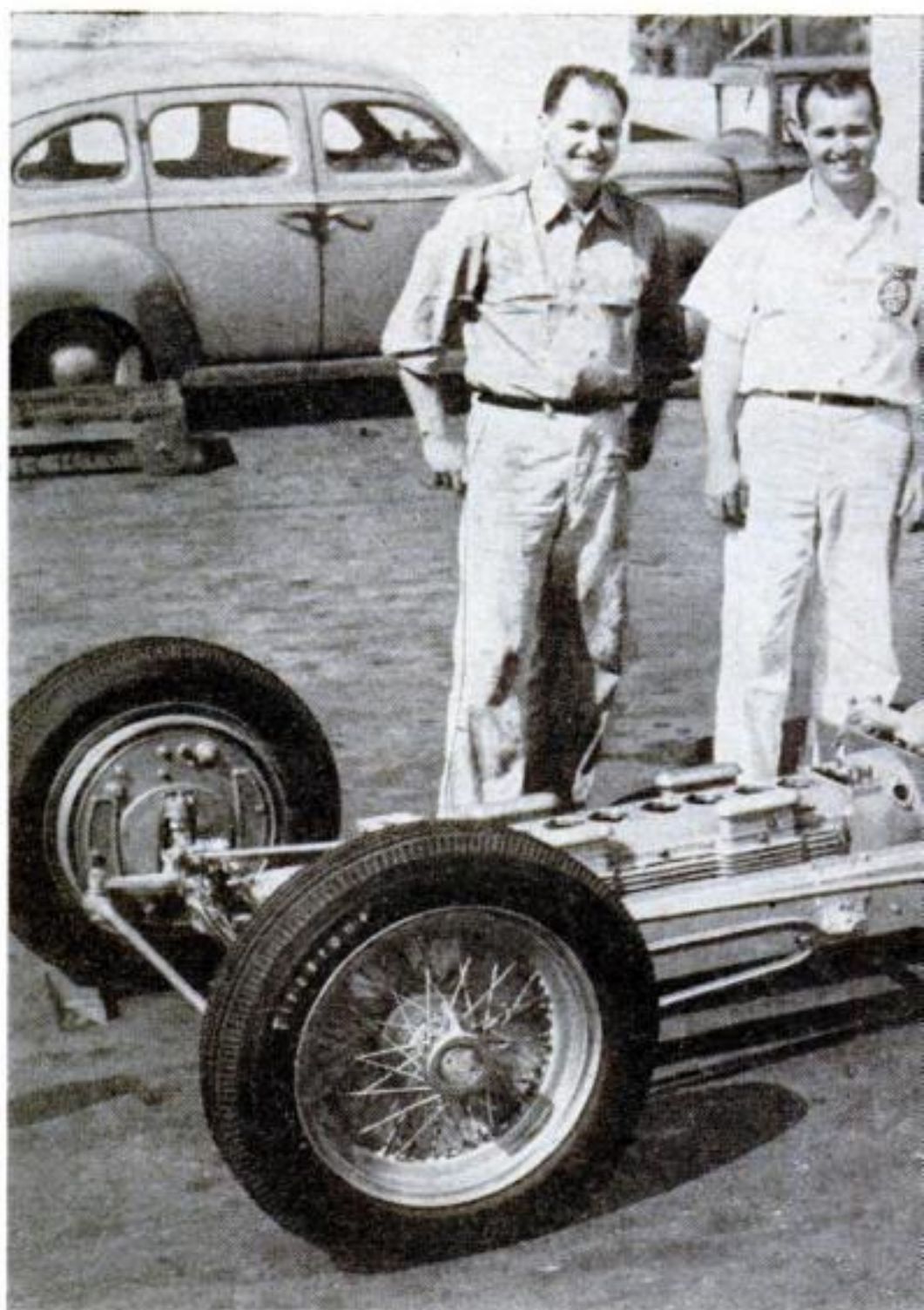




Full torsion-bar suspension keeps Bowes Seal-Fast entry close to the ground, saves weight.



Bird's-eye view of chassis of Bowes car shows how four-wheel torsion mounting replaces springs. Front and rear axles are conventional, as is the racer's channel-type, bolted frame.



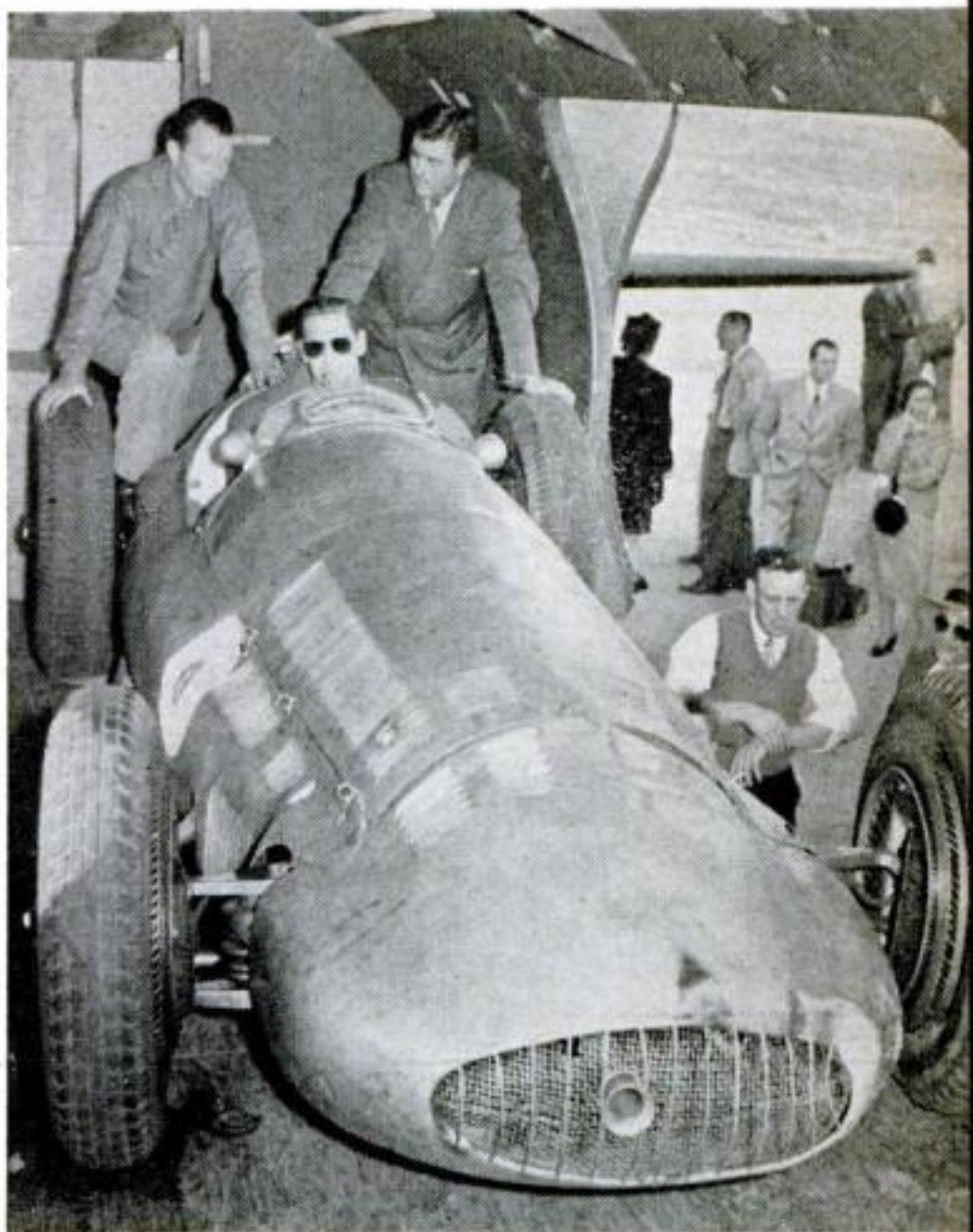
Rex Mays, driver, and Pete Clark, his chief mechanic, beside the stripped Bowes racer. Engine, an in-line eight with only 183-cubic-inch cylinder displacement, turns out 350 to 450 hp.

Speed Kings Get Set for The "500"

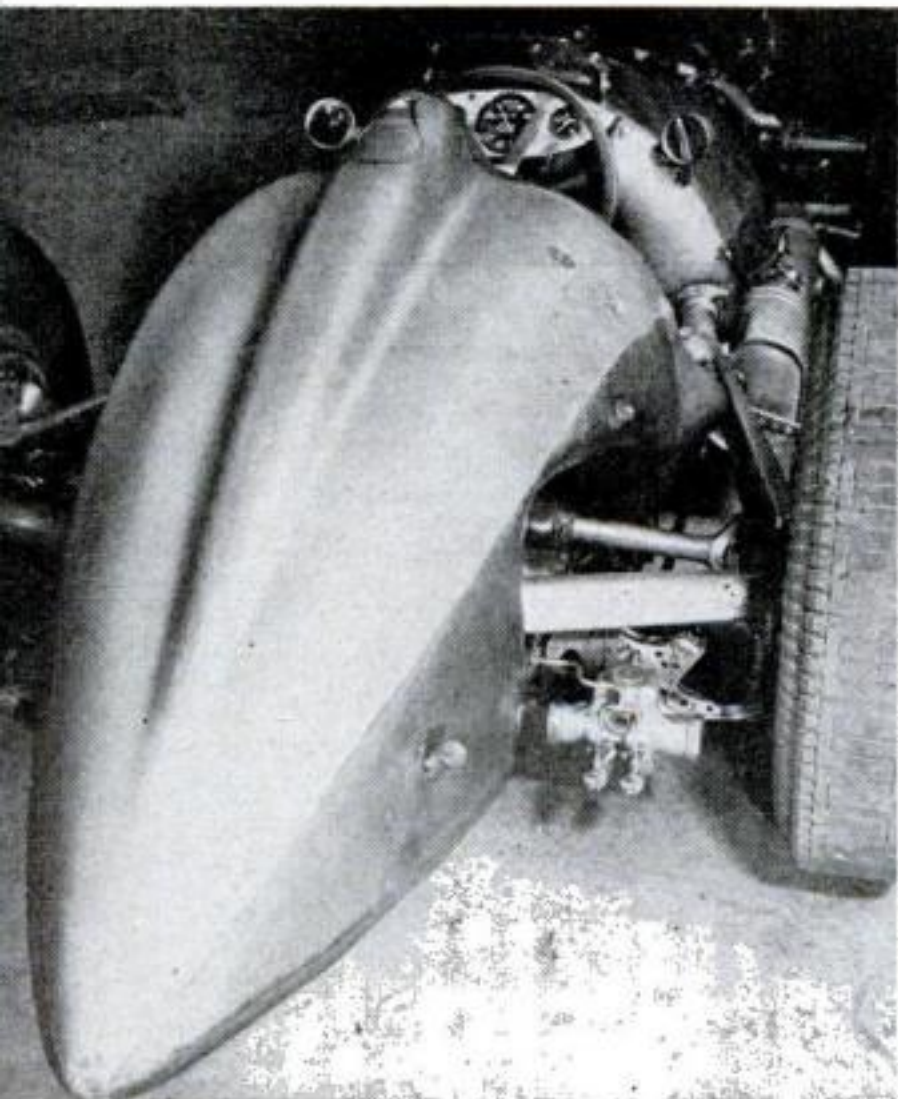
NOBODY knows for sure just what cars will blaze around the Indianapolis Speedway, come Memorial Day, in "the longest 500 miles in the world." But it's already clear that there will be some mechanical marvels in there fighting.

The race is limited to 33 cars, and there are about twice that many entries. Starting May 15, there will be five grueling days of trials. It takes smart design and mechanical know-how to make a car go fast enough, and far enough, to qualify for the Indianapolis 500.

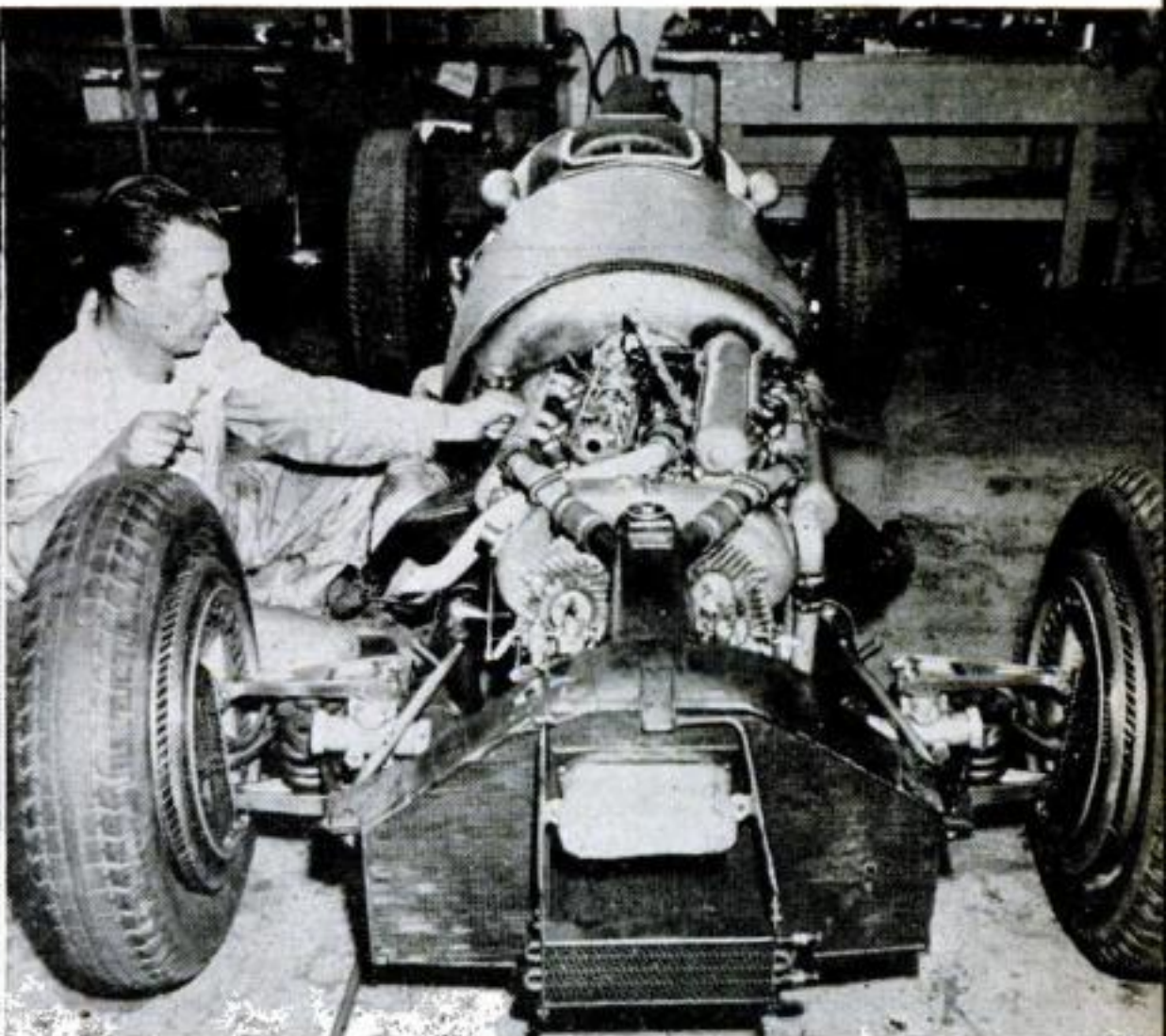
Pictured on these pages are two entries illustrating some of the tricks that will dress up this year's crop of racers. On paper, these two rate among the smartest, fastest designs in the field. But will they qualify in the trials, and if they do, will one of them be the winner? The answer lies at the finish line. You can find out on May 30.



Don Lee entry, a Mercedes Benz, as it arrived by air from Germany. It has done 248 m.p.h., has a manual control that allows driver to select soft or hard ride. Welded frame is tubular.



Mercedes has both cowlings and tail gas tanks as part of body contour. Fine for weight distribution, this is a hazard in a crash. Transmission and differential are both at rear axle.



Twelve-cylinder engine is mounted on the bias, with torque tube on left of driver to permit lower seat. Brakes have turbine-type cooling system, fed by an air scoop on each wheel.



Who's the Winner?

Foot races are often close, but with Bulova's Phototimer Ⓢ, there can be no argument. The camera's "eye" is an open, vertical slit trained on the finish line. The film, moving at about the same speed as the run-

ners, records a progressive picture (above) showing each runner just as he crosses the finish line. Timer dials begin to operate at the start of the race. At the photo finish, the readings are photographed on the top margin of the film, automatically timing each man to 1/100 of a second.

Glassless Lens Beams Radio Waves

WHEN you make a long-distance call from New York to Chicago in the future, you may talk through a man-made copy of a glass lens. For the antennas on A. T. & T.'s new microwave relay network between those cities will be plastic or metal models of the molecular structure of a glass lens.

These new radio lenses can carry a much heavier load than older devices—10 television programs or tens of thousands of phone calls at one time. The old-style, funnel-like metal lenses used on the New York-Boston link are limited to a few hundred phone calls at once.

Radio waves of very high frequency act much like light waves, and it is theoretically possible to focus them with glass lenses. But such a lens might measure 10 feet across and weigh several tons. Therefore, Dr. Winston

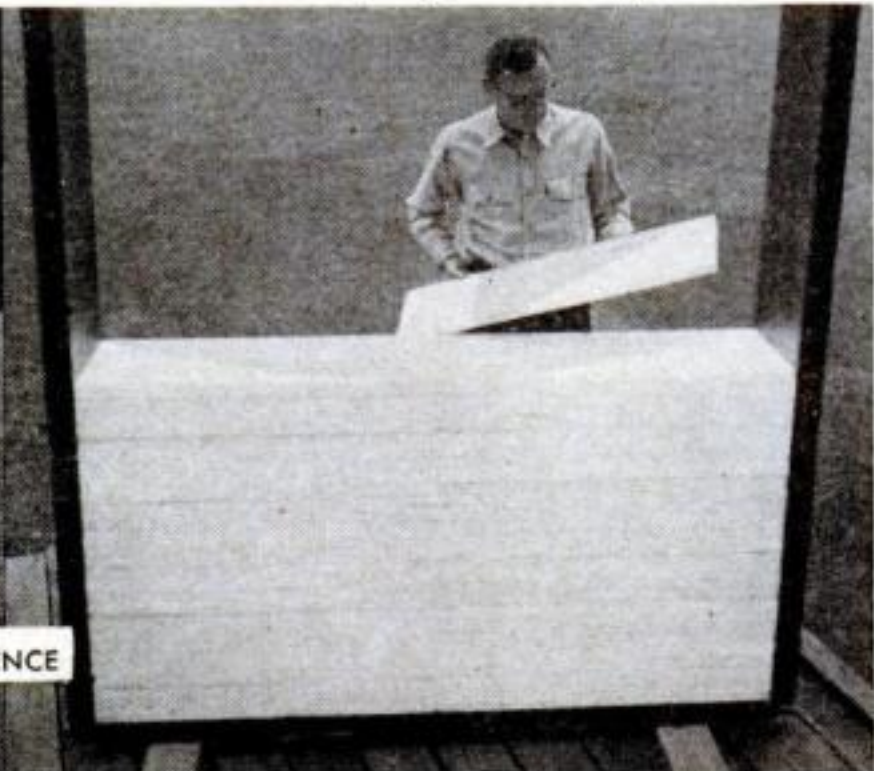
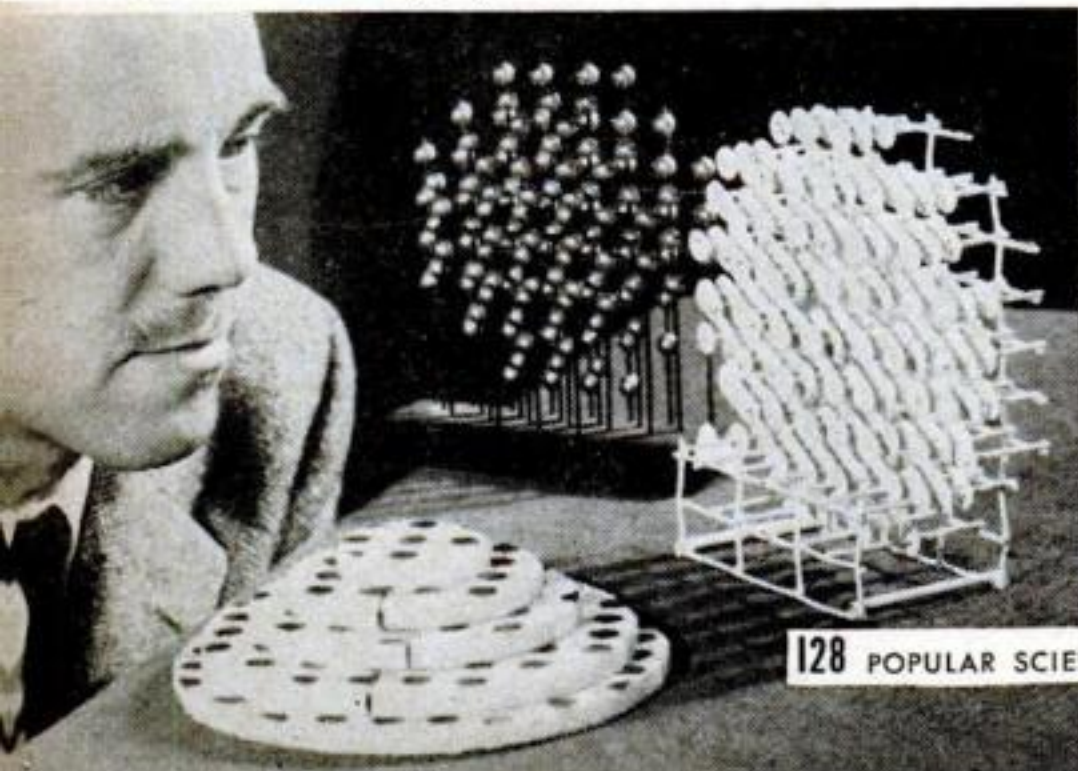
E. Kock, Bell Laboratories' scientist, built a *model* of a glass lens, arranging plastic balls or bits of metal in the pattern that physicists believe real molecules take in a piece of glass.

The trick worked. By correct shaping, Dr. Kock designed a lens that focuses microwaves into a sharp, narrow beam. This concentrated microwave beam sends nearly all the transmitter's power directly to the receiving station, wasting very little. Thus lower-powered equipment can be used.

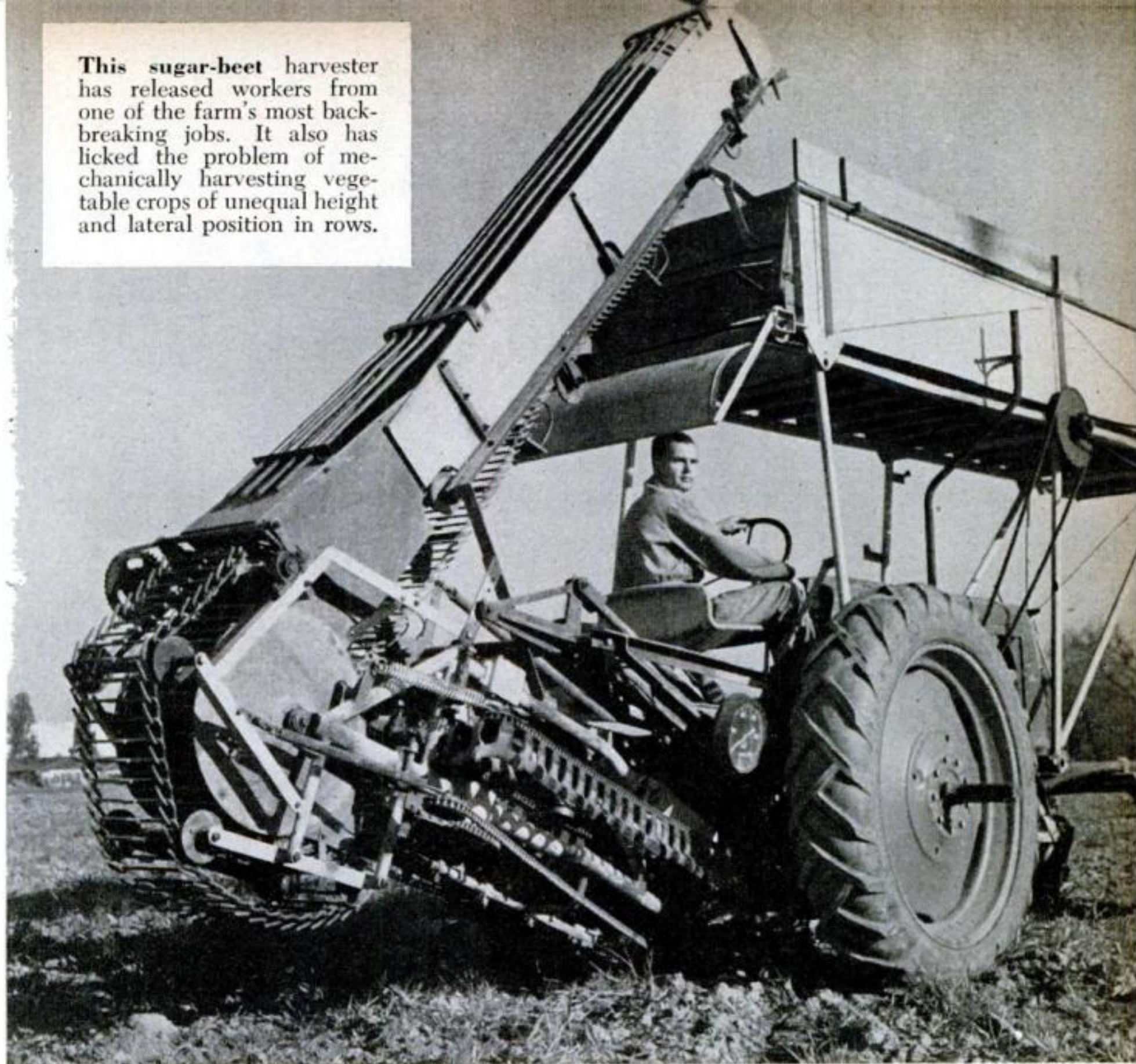
The new lenses are less sensitive to small changes in the wave length of the beam. This means they can handle a broader band of wave lengths without losing sharpness. And the broader the wave-length band, the more traffic that can be crowded into the band for transmission at one time.

Dr. Kock inspects small-scale models of his lens. One in rear uses metallic spheres, and that to the right, metallic disks. One in fore-

ground has thin metallic disks mounted in polystyrene foam. At right, below, a full-scale model of the latter type is being assembled.



This sugar-beet harvester has released workers from one of the farm's most back-breaking jobs. It also has licked the problem of mechanically harvesting vegetable crops of unequal height and lateral position in rows.



Fantastic Farm Machines

Turn Fields into Factories

Woodshed inventors and crossroads shops have given the farmer a whole new set of ingenious machine tools.

By Ladd Haystead

IF a farmer had gone to sleep 20 years ago and just awakened now, he would be so bewildered at what has happened to farming that he literally would be unable to make a crop. If he had gone to sleep

only 10 years ago, he would need at least a refresher course before he could operate.

In 1927 there were more than 15 million horses on farms; today there are only about half that number. Before the war there were a million more workers in the fields than there are today, and 1950 will probably see even fewer men on the farms.

This historic shift has been brought about by farming at long last catching up with industry in the use of machines. But unlike



The lightweight Allis-Chalmers Roto-Baler[®] shown above is operated by one man. It makes round bales tied with twine instead of the

more costly wire used by older types. The rolled bales can withstand rougher handling and are more weather-resistant than rectangular ones.

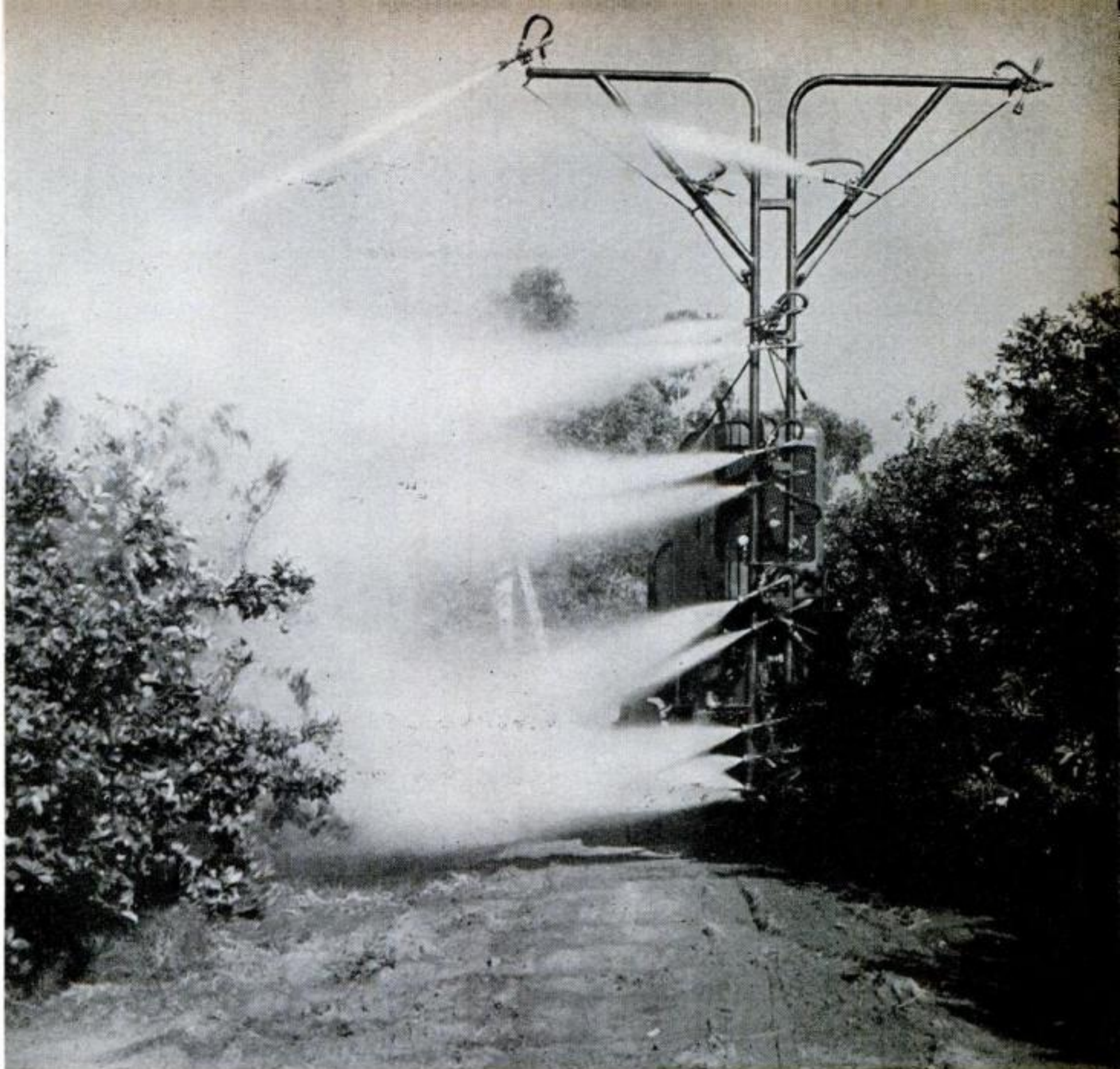
industry, the new farm machines did not as a rule come from laboratory or research departments. The farmers themselves are the fathers of modern farm mechanization. More often than not, the contraptions they invented were machines that by engineering rule "just couldn't work." But, unfettered by rules, these Jules Vernes of the soil went right ahead and made them work.

Farm machines used to be as standardized as a hoe, designed for use in any part of the country. Now many are built for just one crop in one locality. The old-time "full-line" companies aren't that any more. To be actually full-line would mean stocking thousands of items in addition to the already huge inventories the big companies must carry. So small companies build and serv-

ice locally designed machines right in their own back yard.

Typical of the way crossroad inventors harness imagination is the application of the vacuum cleaner to the fields. In California, a huge, portable "sucker-upper" was built to glean ladino clover seed. Besides doing the work of large numbers of laborers, the machine paid for itself in the extra seed it saved over any other harvesting method. Vacuum sweepers also have been designed to pick up apricots, almonds, and filberts after they have been shaken off the trees. And there is a mechanical tree shaker: simply a pole or cable that jerks back and forth when hitched to a tractor pulley.

During the war the hop crop was in danger of being lost because of labor short-



The war against insects grows apace, with Man just about holding his own despite more powerful chemicals and better distributing methods.

The dual-boom sprayer, shown above, shoots out chemicals in two directions at once from 16 short guns. It reaches a height of 15 feet.

ages. It was saved by an improvised portable hop picker. Then came a mobile vine-seed harvester to collect pumpkins, melons, and gourds whose seeds are a specialty crop. Bren-gun carriers on surplus sale were snapped up by rice farmers who always had trouble entering the wet fields to unload the rice combines.

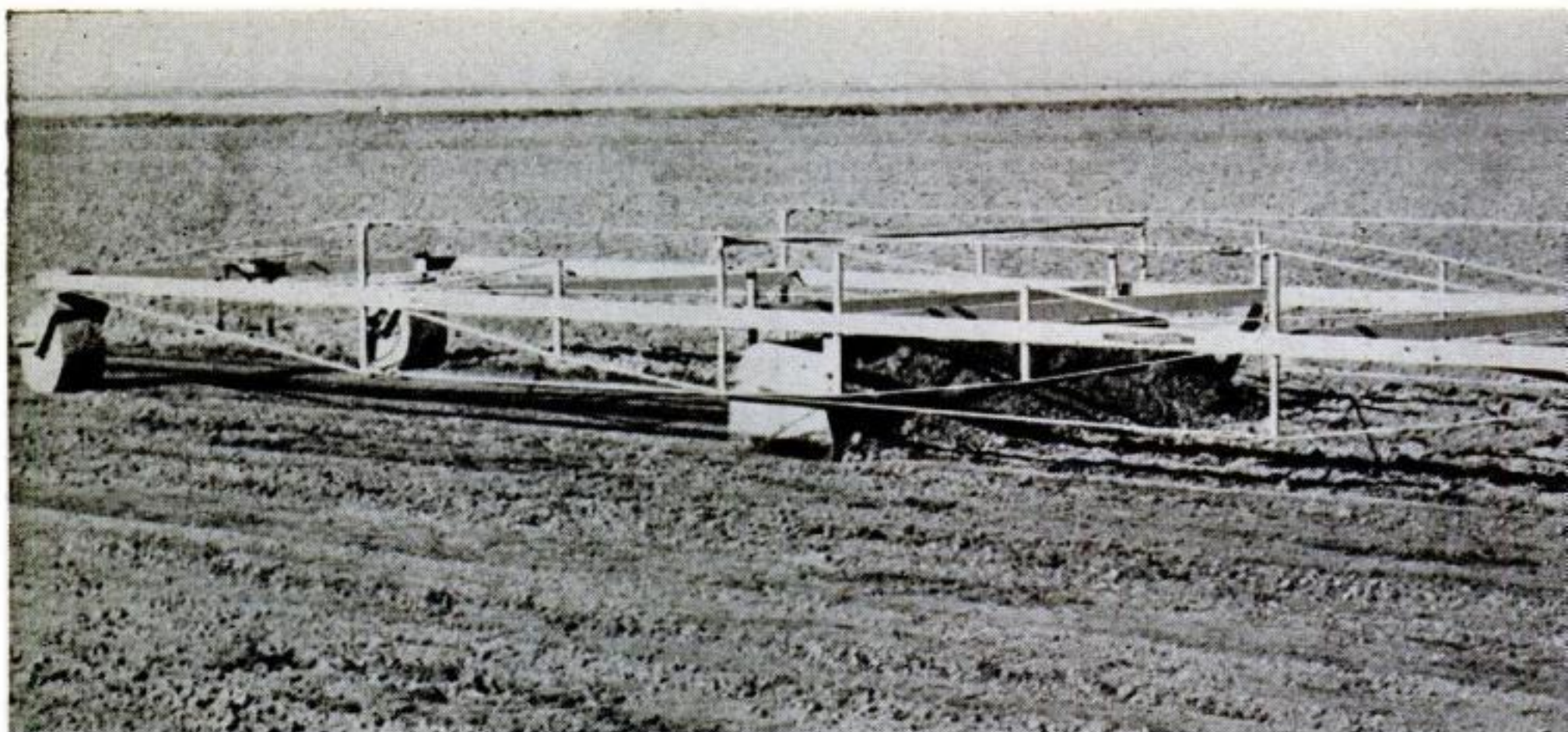
Peas and Beets Get Machine Treatment

As this is written, the first pea combine is being announced by the Universal Harvester Co., of Stockton, Calif. No more popping of pea pods by hand, or even collection by tractor-mower for hauling to a field machine-sheller. One machine picks and pops right in the field.

But the Pacific Coast is not the only area

that has felt the impact of mechanization. Sugar-beet fields from Sacramento to Michigan are almost empty of the crews of tens of thousands of "stoop" laborers that used to do the man-killing work of beet culture. Now the seed that comes naturally in rosettes is segmented by a sort of motor sander. The seed is then planted by new precision seeders. By this method, beets no longer grow in clusters that have to be thinned out by hand. Weeding can be done by machine-powered checkrowing or cross cultivation. Then the most Rube Goldbergish of all the new machines, the sugar-beet harvester, comes along, doing the work of anywhere from 10 to 75 men (PS, Feb. '48, p. 158).

This machine, in its newest form, cuts the beet tops off and delivers them at the side



Level land prevents water puddling, speeds farm operations, cuts costs. The Landplane®

for making cattle feed. The beet itself is gently freed from its tight soil packing so the tap roots will not be broken (as in early models). Then it is lifted, shaken clean, and elevated to a hopper riding above the tractor and mounted digger. The hopper has a moving bottom sheet that gently pushes the beets ahead so that the box may be filled without bruising the easily damaged tubers. A big hamper enables the machine to work to the end of a row where a collection truck waits.

Soon an onion digger, now under field testing, will take the pain out of harvesting that crop. This machine is mounted on a tractor. It is light and fully automatic. It snatches the onion from the ground by its green topknot, shakes it, snips off the greenery, and delivers the bulb either to the side or directly behind to a pulled trailer. One man can do the job of 25 hand pickers.

Attachments Are All-Important

In New England, some tired-of-it-all farmers have developed a stone picker to remove the endless crop of rocks from the fields. In Wisconsin, an amateur has put hydraulics to work in a hay baler, getting away from the heavy flywheel that pushes the plunger in most models. In Louisiana, a mechanical sugar-cane harvester is at work.

Not so long ago, most farmers couldn't afford tractors; there wasn't enough steady work to justify the cost for the very few jobs they could do. But during the war, farmers and woodshed inventors every-

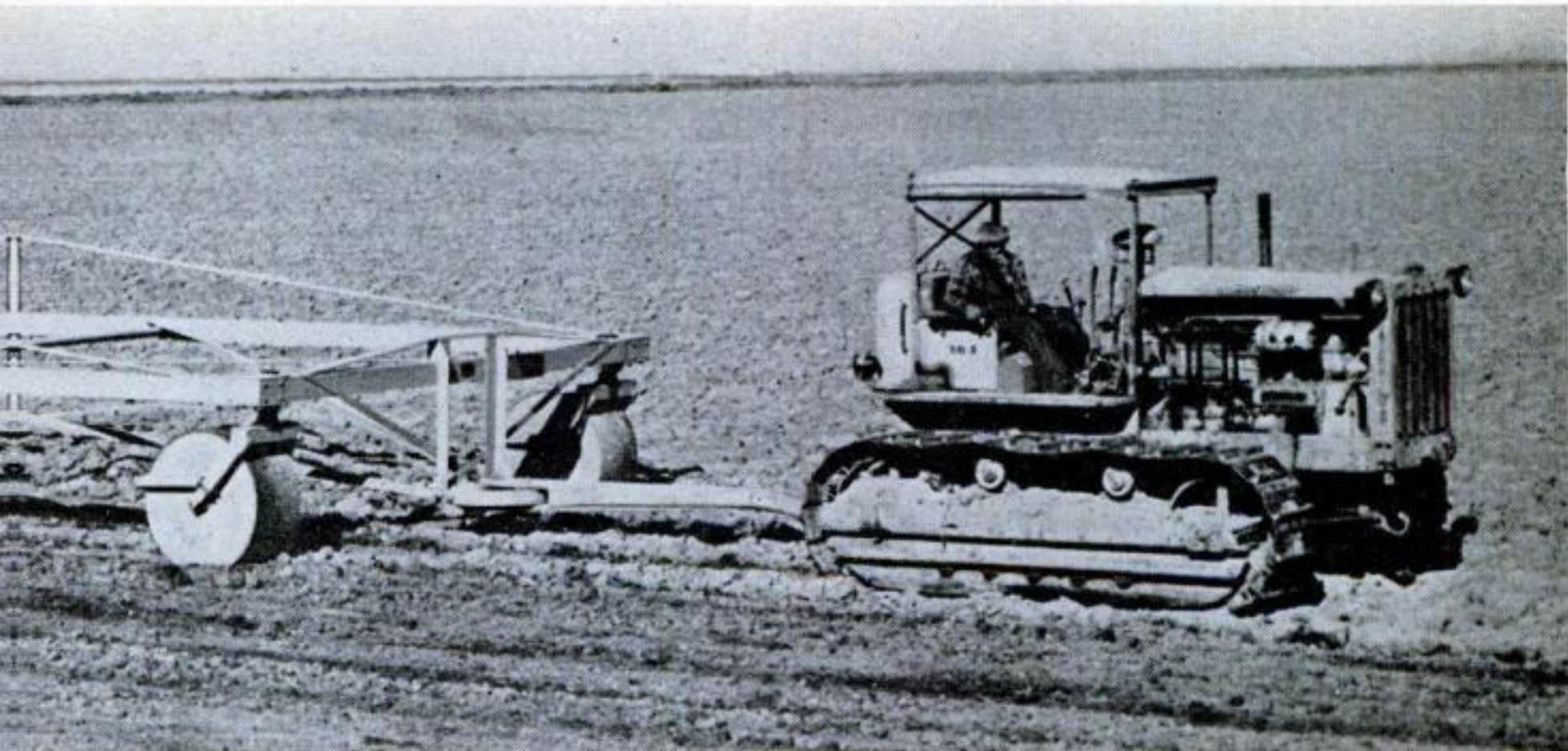
where started to build their own tractor attachments. These gave the power units uses not even dreamed of a few years before.

A combination front-end attachment, for instance, can be an excavator, manure loader, terracer, snowplow, ditcher, and elevator all in one. Posthole diggers for tractor attachment are now a feature of every farm show. A mounted, power-take-off concrete mixer for the Ford tractor is on the market. Wood saws are appearing that work either from the tractor pulley or the power take-off.

One ingenious man concluded that painting farm buildings the old way was the hard way, too costly, and too dangerous if one had to lug ladders all day and possibly fall off one. So he built a scaffold on his tractor elevator and attached a paint spray to the engine. Now he can be lifted up and down, driven laterally or from job to job by his son. The power spray makes it possible to paint in hours what took days with hand brush.

The three-legged stool, badge of the dairyman, is disappearing just as fast as farmers can get materials to build milking platforms. Now the cow climbs a ramp, stands in a stall at hand level instead of the man stooping down. The milker standing at work-bench level can keep anywhere from three to six cows going at once.

Silos are fed out by electrical unloaders, while barn gutters are cleaned by mechanical gutter washers. Hay is elevated into the mow by mechanical bale elevators in some places; it is blown in as chopped hay in others. It can be brought in from the



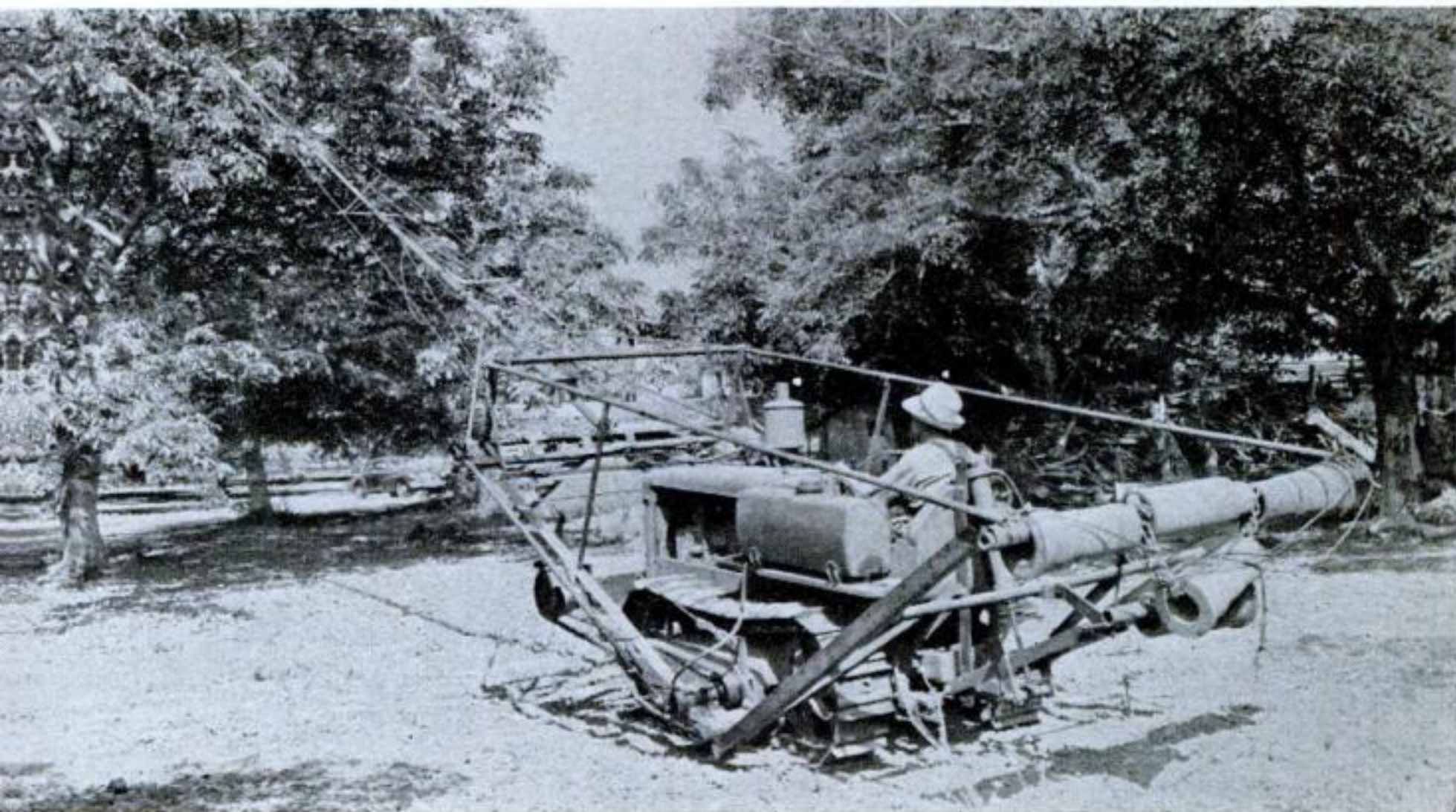
(above) shaves $6\frac{3}{8}$ acres an hour at a cost of about 60¢ an acre. It is 80 ft. long, 15 ft. wide.

fields, either as long or chopped hay, in a high state of moisture for mow-curing in new installations using heated air blown up through floor ducts. Some users say they can just about make hay while the rain falls.

In Connecticut, a scientist is working with a variation of radar to select seeds that will grow best. If his work is successful, the farmer will plant only seeds that will assure

him the most vigorous and highest-yielding growth. Another inventor is on the verge of success with an electronic tomato harvester that will select the fruit by color and size.

Perhaps the most exciting news of all is that we now stand on the threshold of industrial farming with chemicals. Large acreages of corn in the Mississippi Valley, apparently doomed last year, were saved by 2,4-D. ➡



The mechanical tree shaker is a farm-invented device. Formerly nuts and some fruits were harvested by men using long, hooked poles, a

tiring and costly method. The tractor-powered machine pictured here can shake out 50-foot walnut trees at the rate of 10 acres a day.

This chemical is now in such demand by scientific-minded farmers that this year's total production of millions of pounds will not satisfy even a fraction of the requirements. And right on 2,4-D's heels comes the announcement of other selective killers, such as BHC and IPC, to lighten the farmer's work.

These and numerous other chemicals suggest that mechanical cultivation may become as outmoded as the wooden plough. Weeds and pests probably will be controlled completely by spraying and dusting. Some farmers are talking of combining the pesticides with fertilizer so that one trip over the fields can do two jobs (PS, April '48, p. 108).

Airplane Does Farm Jobs

This is one of the things that has brought airplanes into the farm picture. Planes spray fields for weeds, bugs, fungi, and fertilization. In the Southwest, airplanes are seeding vast areas of over-grazed range as well as tree lands for reforestation. Killing leaves on cotton plants to pave the way for the big mechanical harvesters is almost entirely a plane job. In California, planes are used for herding wild fowl away from rice fields.

Perhaps the most Sunday Supplementish of all ideas came out at a recent Northeastern Forage Conference. In Cambridge, Mass., a maker of ultrasonic equipment announced strange and wonderful things were being done with sounds above the hearing capacity of human ears, sounds like those made by silent dog whistles. With them such fan-

tastic things as stopping the action of yeasts and killing bacteria can be done.

There was an immediate request for experiments using sounds to halt all chemical action in a silo. With such a device, forage crops could be brought from the field when their carotene content was highest. Regardless of weather, they could be dumped into the silo and literally "sound frozen." No bug, germ, bacteria, or enzyme could get in its dirty work until the silage was opened.

Thus it seems possible, at least on paper, for milk cows to give as rich, cream-colored milk in January as in June, licking another farm problem. And if ultrasonics can do this for hay, there is little reason why many other feed and food crops can't be protected in storage for long periods of time. This would mean a saving of possibly billions of dollars a year now lost on crops in storage that are destroyed by bugs, weevils, and fungi. The perfection of this technique is close enough at hand so that provisions for its use are already being made in flour mills and grain elevators.

Today helicopters and infrared rays are used to protect orchards from frost; dry ice from ~~airplanes is making rain~~; germicidal lamps are protecting poultry from disease; and radios that bring in the World Series are in the barn and on the tractor.

About all that is needed to eliminate labor completely is an Automatic Income Tax Calculator that can understand the forms the farmer has to make out, in many cases for the first time. END



For generations American farmers destroyed crop wastes, with the result that the humus content of our soils disappeared. Modern farm-

ers chop and turn under all organic matter as this roller-chopper is doing to the leaves and stalks of a date grove in Southern California.



"Behind the scenes," busy attendants transfer horses from wagon to tent at right. Tent in left background is "air-conditioned" Big Top.



Model Circus Rivals Real Thing

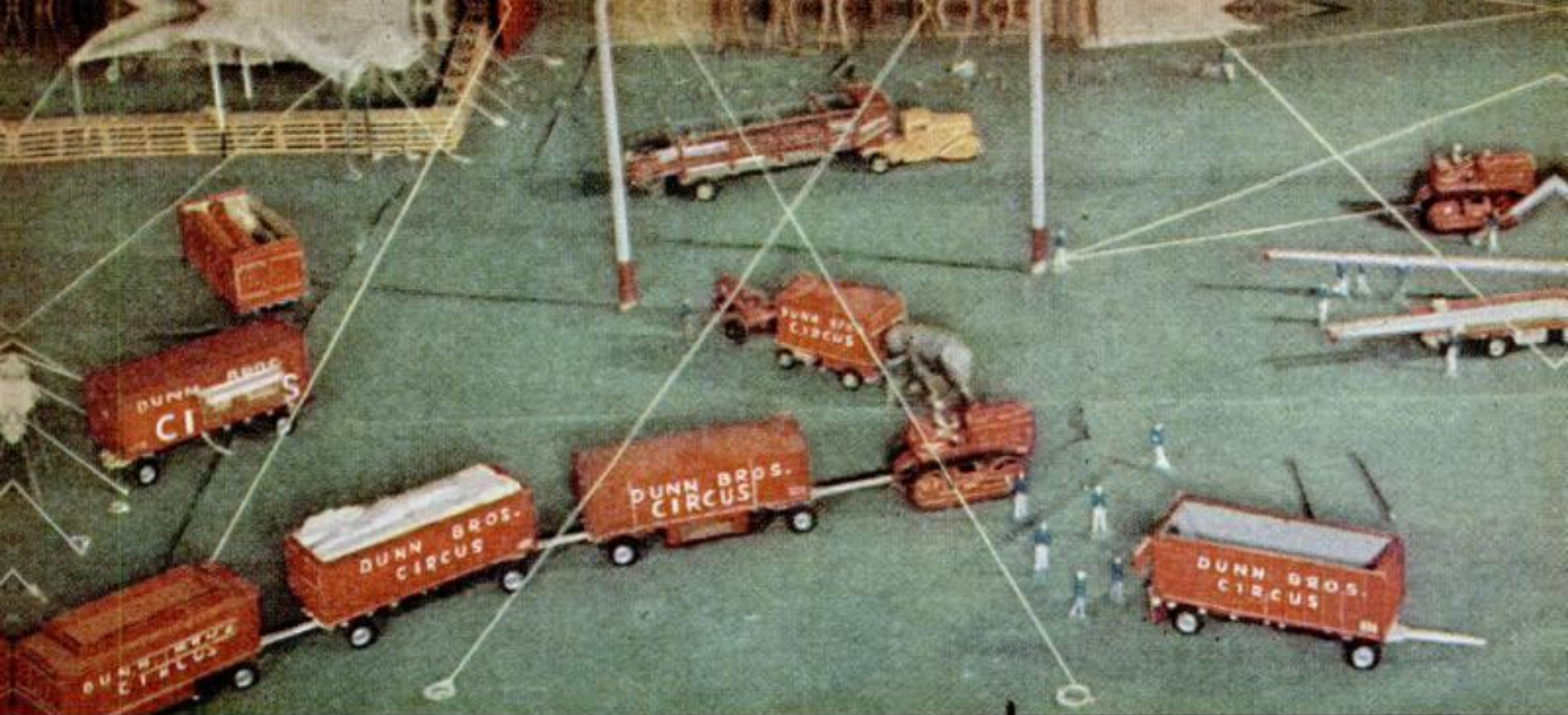
PS photos by Hubert Luckett



At light-control panel, J. Harold Dunn accompanies a performance with spoken commentary over microphone and public-address system.

"THE biggest little show on earth" is a 34-by-83-foot circus in miniature. J. Harold Dunn, of Kansas City, Mo., spent 18 years building it. The exhibit now tours the country, drawing crowds of children and grownups to see famous professional "acts," faithfully simulated on a scale of one-half inch to the foot. The Dunn Bros. Circus (the "brother" is imaginary, a familiar fiction in show business) boasts 54 tents, 4,500 miniature people, and 3,500 animals.

Dunn himself whittled patterns for the plastic human figures, hand-carved some of the animals from wood, and modeled others of papier-mâché. Most scenes are stationary tableaux, but a 150-foot-long parade is animated by hidden mechanism. An electric control panel varies lighting from a "day" scene with flood lamps to a picturesque "night" effect with 500 midget bulbs, as shown on the following pages.



COMING TO TOWN in miniature wagons, circus is "set up" on its lot with aid of tractors and elephants.

BALLYHOO MEN, flanked by freaks and hula dancers, beckon circus-goers strolling down Midway

to the supercolossal attractions of the sideshow in illuminated tent at rear. Hot-dog stands and balloon

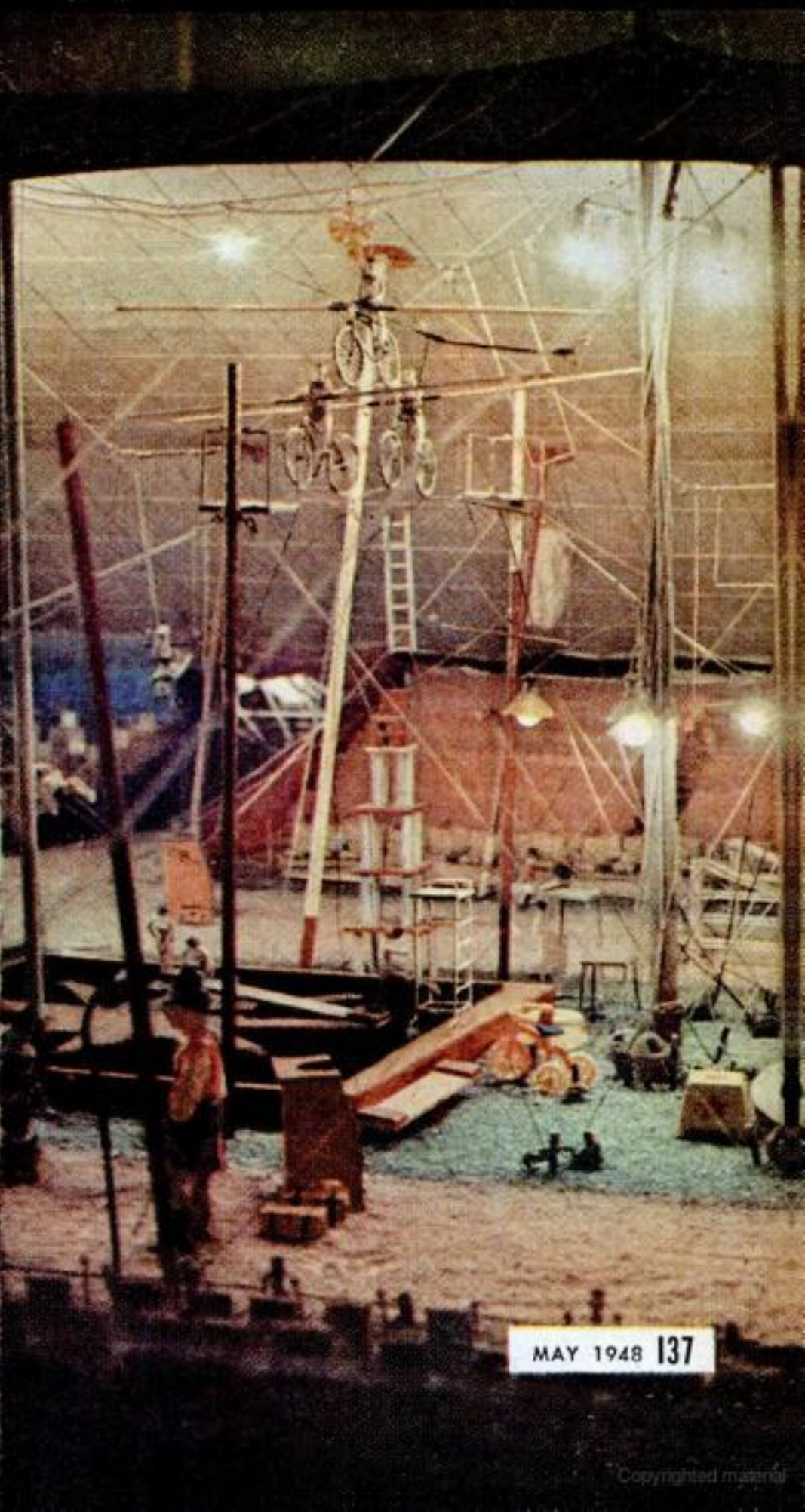




GALAXY OF ACTS in three-ring, four-stage Big Top includes lion tamer, acrobats, and trained animals.

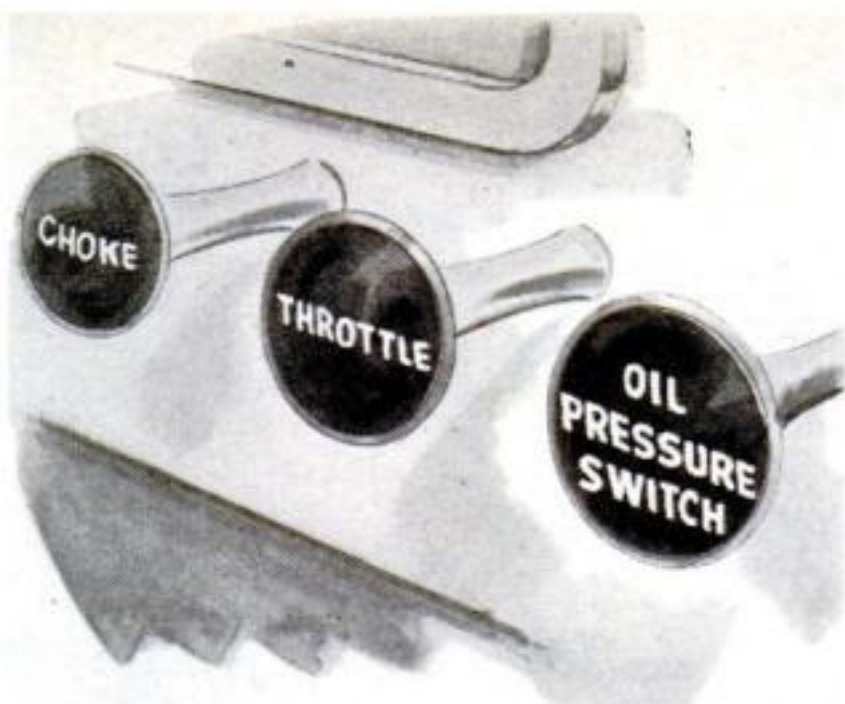
vendors offer their wares to passers-by. Midget bulbs provide the lighting for this picturesque "night" scene.

DAREDEVIL AERIALISTS' act vies for attention with tumblers' antics on the Big Top stage shown below.

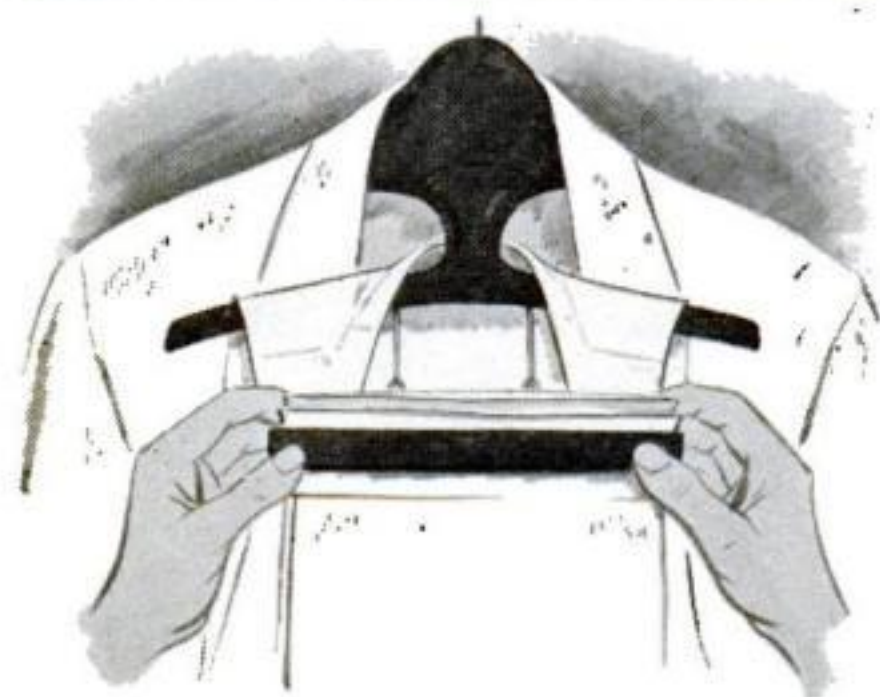


I'd like to see them make...

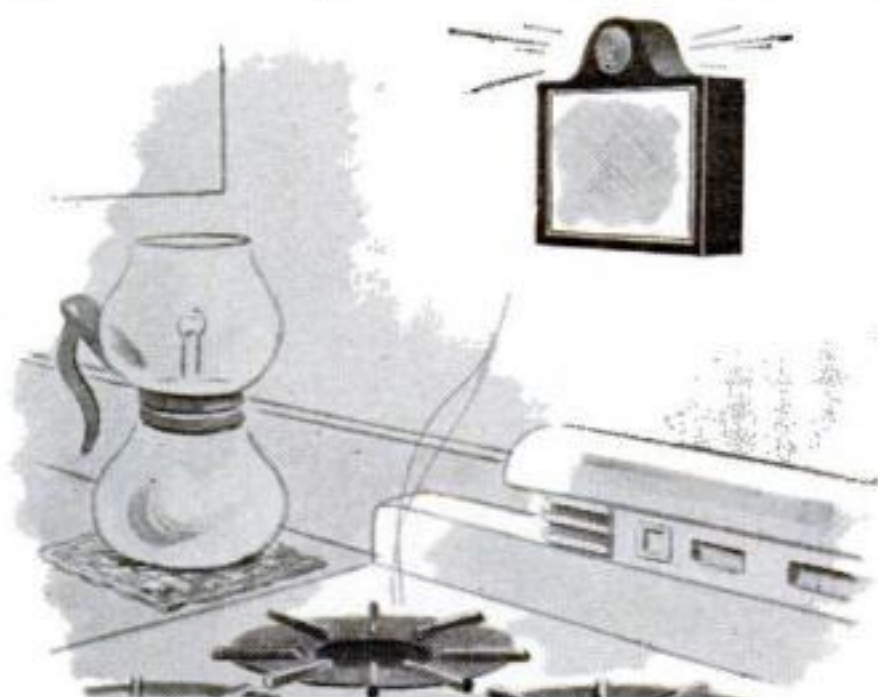
Everybody has his own pet idea of some gadget he would like to see in general use. What is YOURS? Popular Science will pay \$5.00 for each one published. Use government postcards only. Contributions cannot be acknowledged or returned.



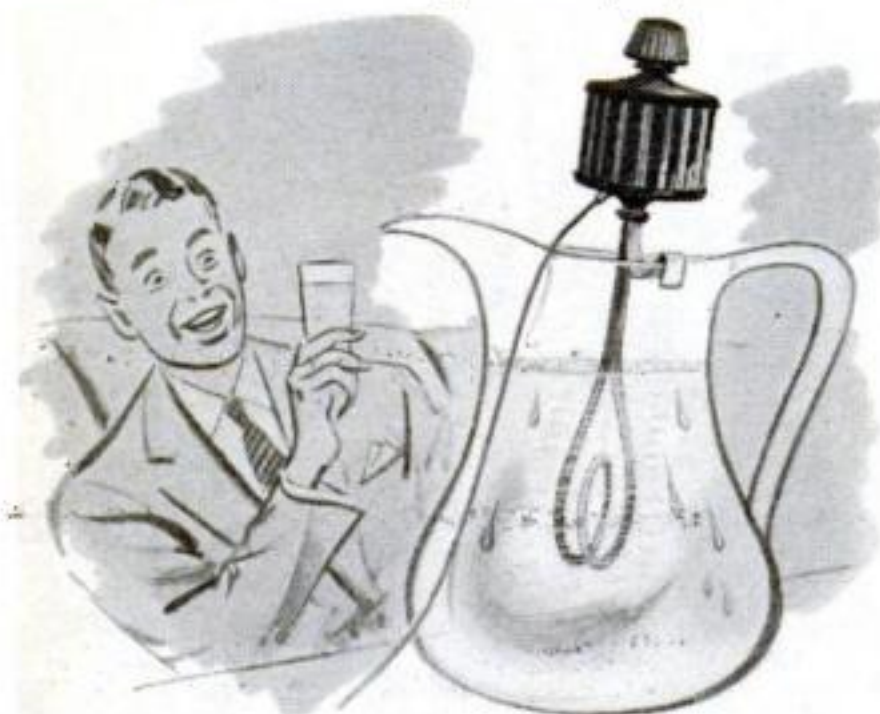
A Protective Switch for Cars. An automatic switch that would blow the horn when oil pressure fails would avoid engine damage. For starting, a dash button could bypass it until pressure built up.—D. L. West, Vallejo, Calif.



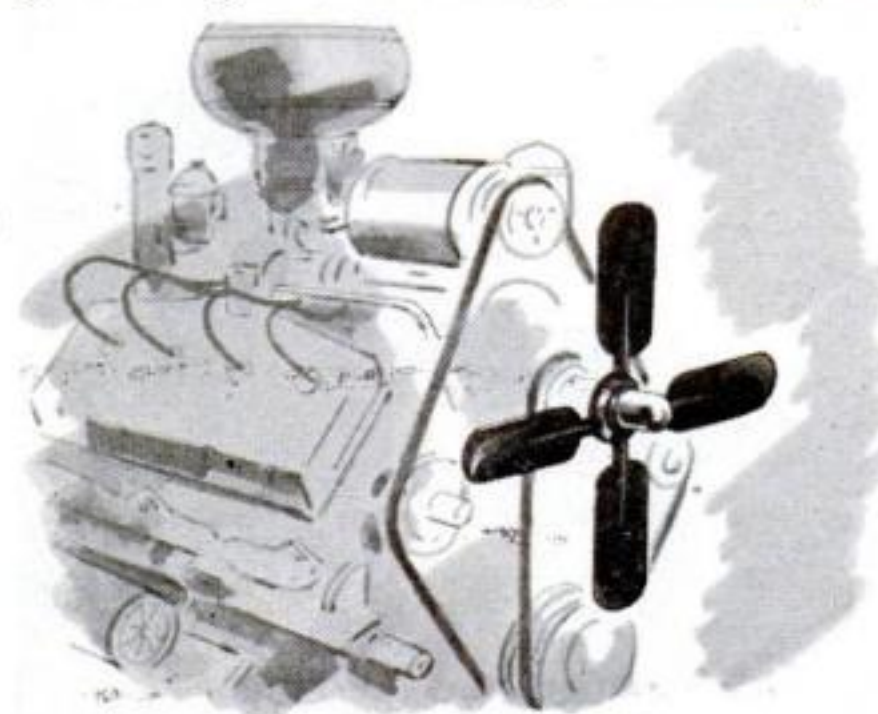
Hangers to Take a Coat First. It'd be great to have a clothes hanger on which you could place your garments in the order you usually remove them—coat first, vest next, and your trousers last.—Fred Way, Burlington, N. C.



An Escaping-Gas Alarm. Why doesn't someone make a bell alarm that rings if escaping illuminating gas builds up to a dangerous concentration? The alarm would be especially good at night.—M. W. Scott, Wilkes-Barre, Pa.



Portable Coolers. Perhaps the principles of an immersion heater and electric refrigerator could be combined in a compact gadget to cool a container of drinks. You'd just immerse the cooling coil.—Irene Treece, Artesia, N. M.



Fans You Could Disconnect. Car engines would warm up sooner on cold mornings if you could disconnect the fan or vary the pitch with a dash control. A thermostat also might do it automatically.—P. Hubschmitt, Paterson, N. J.



Which is linoleum? You've walked on these two floor coverings many times. One is linoleum,

the other felt-base flooring. Can you tell them apart? See illustrations below for the answer.

How to Look at Linoleum

This backstage visit to the Armstrong factory tells you what you should know in order to buy floor covering wisely.

By George H. Waltz, Jr.

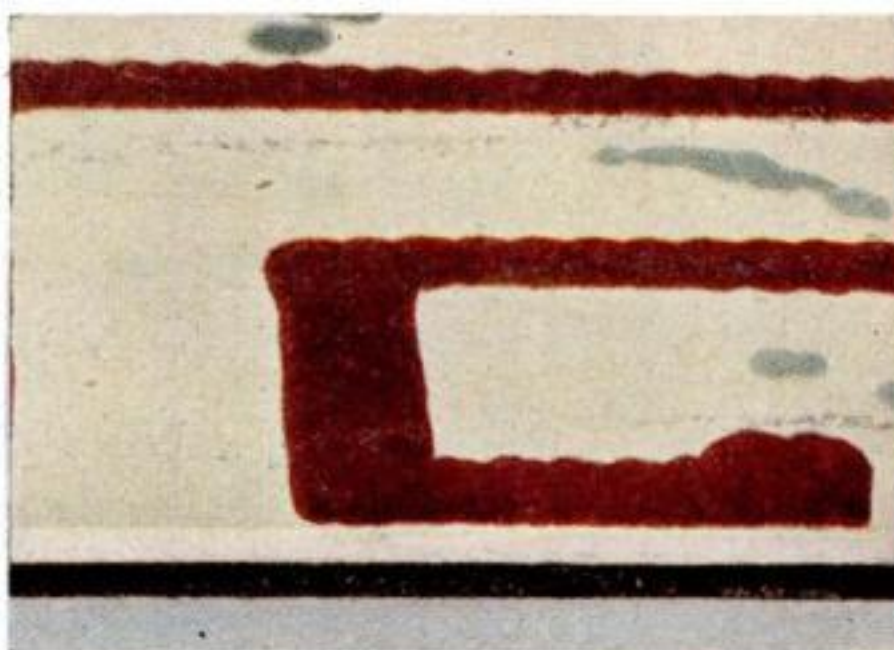
PS photos by W. W. Morris

HOW many times have you glanced down at the smooth, colorfully surfaced floor of some neighbor's kitchen and thought "linoleum"? If you live in a typical American community, your offhand snap judg-

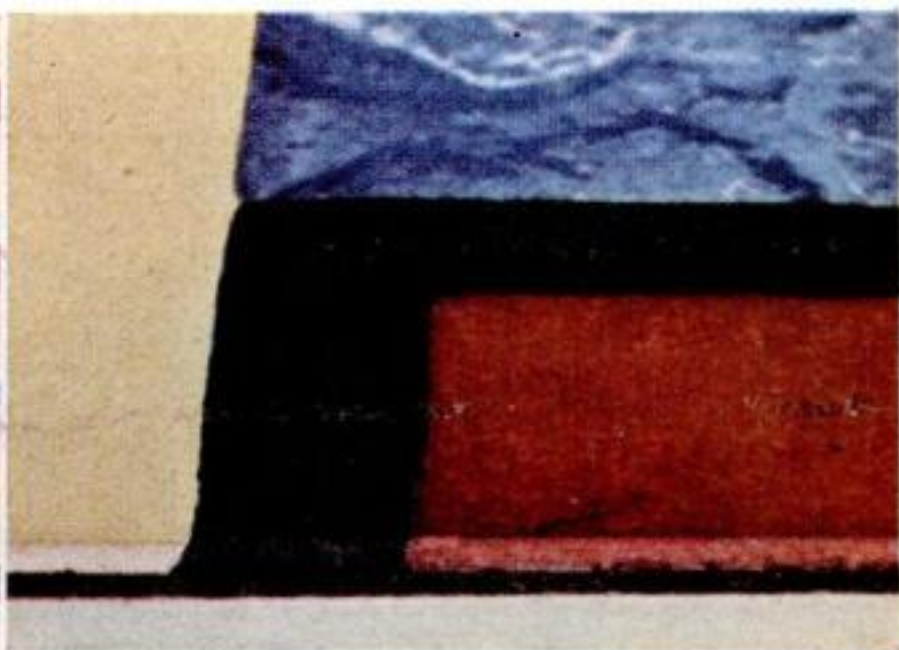
ment has probably been wrong half the time. Not all that glitters underfoot is linoleum.

"Linoleum" is probably one of the most frequently misused words in our language. It is not a handy tag for any resilient floor covering. Neither is it a trade name. Linoleum is a specific label for a certain type of product. There are other types of colorful flooring. And each of them has distinguishable characteristics and its own peculiar and interesting advantages.

Most frequently confused with linoleum



This is felt-base floor covering. Notice how the colored design is just on the surface. Here the color has no thickness, but is simply "printed" on the felt base (black line at bottom).



This is linoleum. Notice how colors and design go right through the thick layer of material above the felt backing. Thus the design will last as long as the material itself.

is the printed felt-base type of floor covering. This can be bought in rug form or by the yard in a wide sheet. Felt-base is a colorful, low-cost covering that is easy to keep clean and wears well dollar for dollar—but it is not linoleum.

What's the real difference between linoleum and felt-base? How can the man of the house tell them apart? Why is linoleum more expensive?

To find out, Bill Morris, PS crack photographer, and I went to Lancaster, Pa., to tour the sprawling 110-acre flooring-division plant of the 85-year-old Armstrong Cork Company. Some 616 photographic flash bulbs, dozens of color and black-and-white films, reams of notes, and four very tired feet later we climbed back into the POPULAR SCIENCE editorial scout car with answers to these and a good many other questions.

Before we had traipsed far, we had learned the simple difference that can be detected by the untrained eye. Felt-base floor covering is a printing job much like the pages that you are reading. Replace the paper with a specially processed rag felt and the ink with carefully mixed, long-wearing enamel paints and you have a felt-base floor covering.

Linoleum, on the other hand, is more like the cloth in your suit in that the pattern is "woven" in. Hence, the design cannot wear off. The colors go clear through to the backing, and remain crisp and sharp as kitchen traffic scuffs away the surface over the years.

This major difference between linoleum and felt-base floor covering makes it easy to tell one from the other. When in doubt, look

at the edge of the material. If the colors in the design go through from the top surface to the backing, it is linoleum. If all you can see is a thin layer of color on a thick black backing, then the material is felt-base floor covering.

There was a time when you could tell linoleum from felt-base simply by looking at the floor side of the material—linoleum was always backed with burlap. Now, with modern advances in the industry, felt is used as a backing for linoleums as well as a base for felt-base.

Flax and Oil

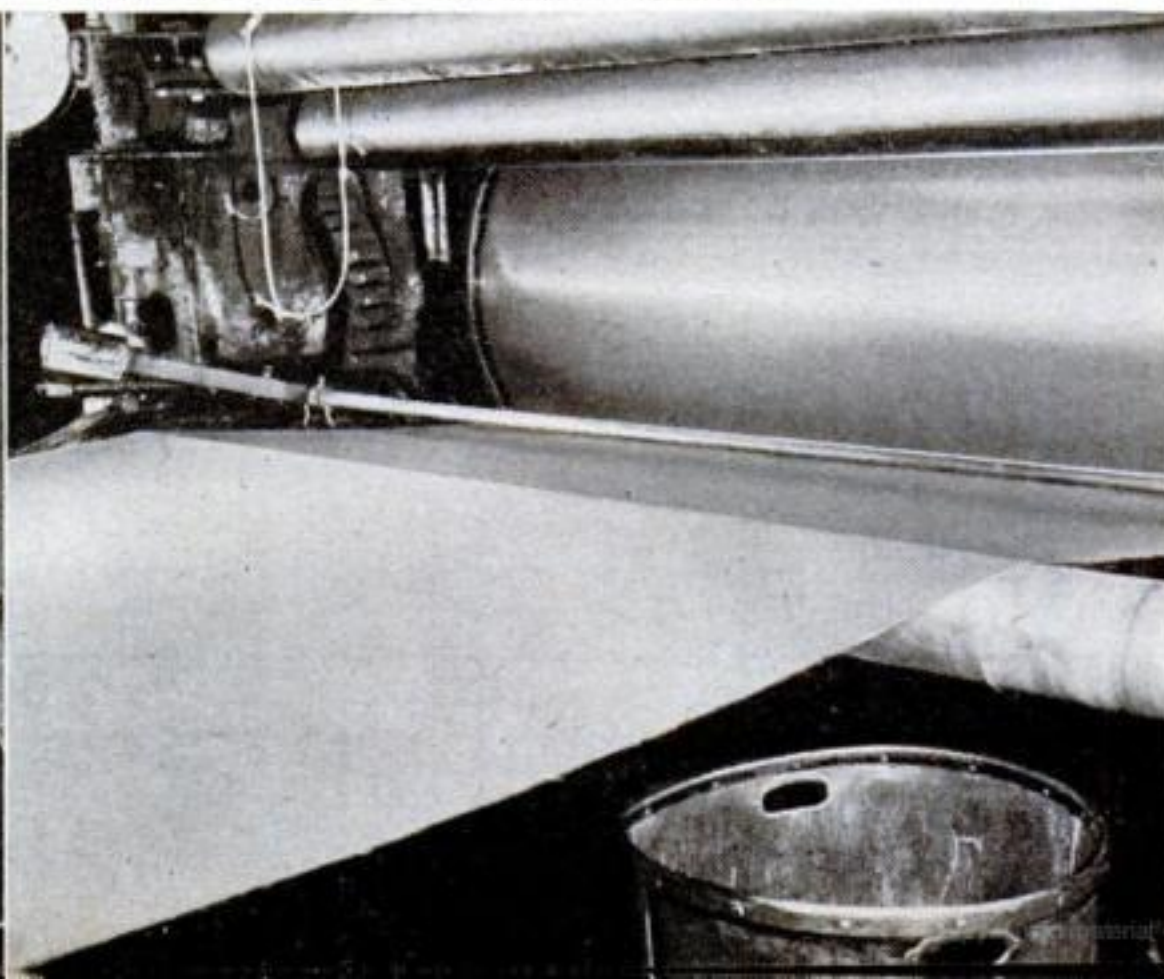
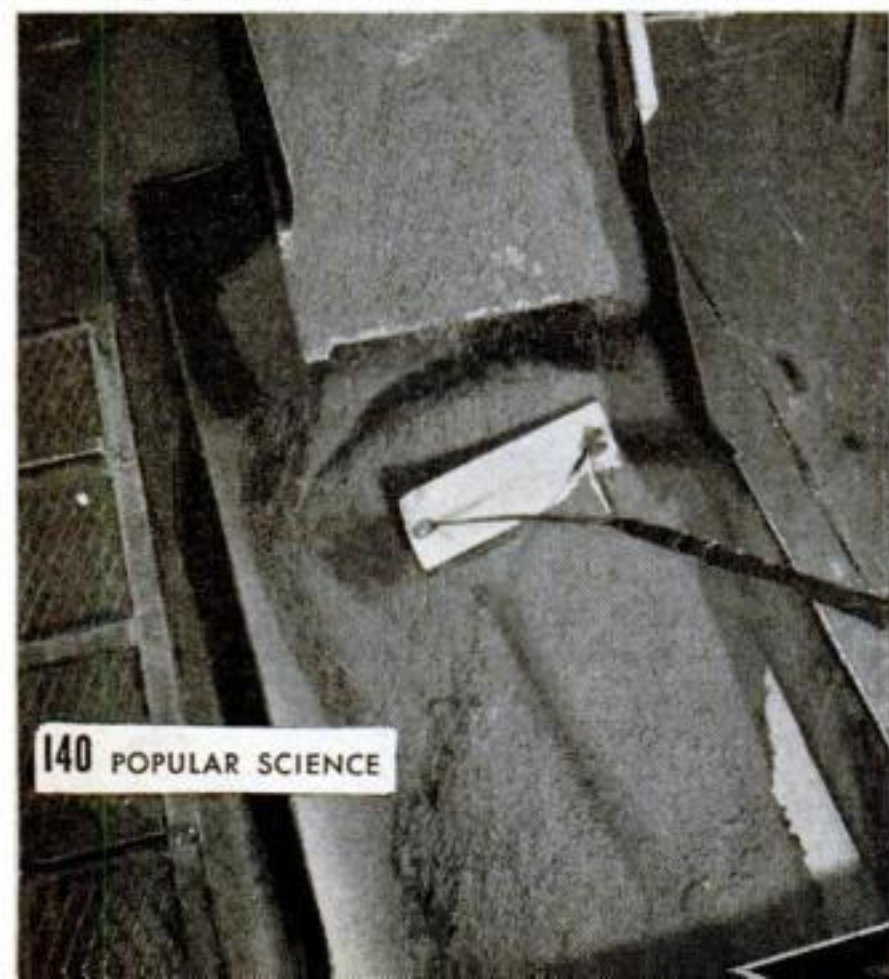
Linoleum comes by its name honestly. In Latin, *linum* means flax and *oleum* is the word for oil. Combine the two and you get flax oil or, more commonly, linseed oil, the main ingredient in linoleum as well as paint.

As a matter of fact, that bothersome tough scum or film that forms on the top of an old can of paint is the basis of all linoleum. It is oxidized linseed oil. This, mixed with wood flour or ground cork, color pigments, and powdered limestone, forms the basic linoleum mix or "batter" that is spread out on the felt or burlap backing and bonded to it with heat and pressure.

Of the five main types of linoleum—(1) plain, solid color, (2) jaspe, (3) marbelle (marbleized), (4) straight-line inlaid (the tilelike and inlaid-design types of patterns), and (5) embossed—the plain is the simplest to manufacture. The mix is fed directly into the open hopper of a machine that resembles a giant clothes wringer and is called a "calender." One of this machine's two slowly

Making plain linoleum. The linoleum mix is first fed into the hopper of a big calendering machine. This mix contains cork flour, limestone, pigment, and oxidized linseed oil.

Like a giant clothes wringer, the two cylinders of the calendering machine spread the mix out on the backing in just the right thickness to make the gauge of linoleum desired.





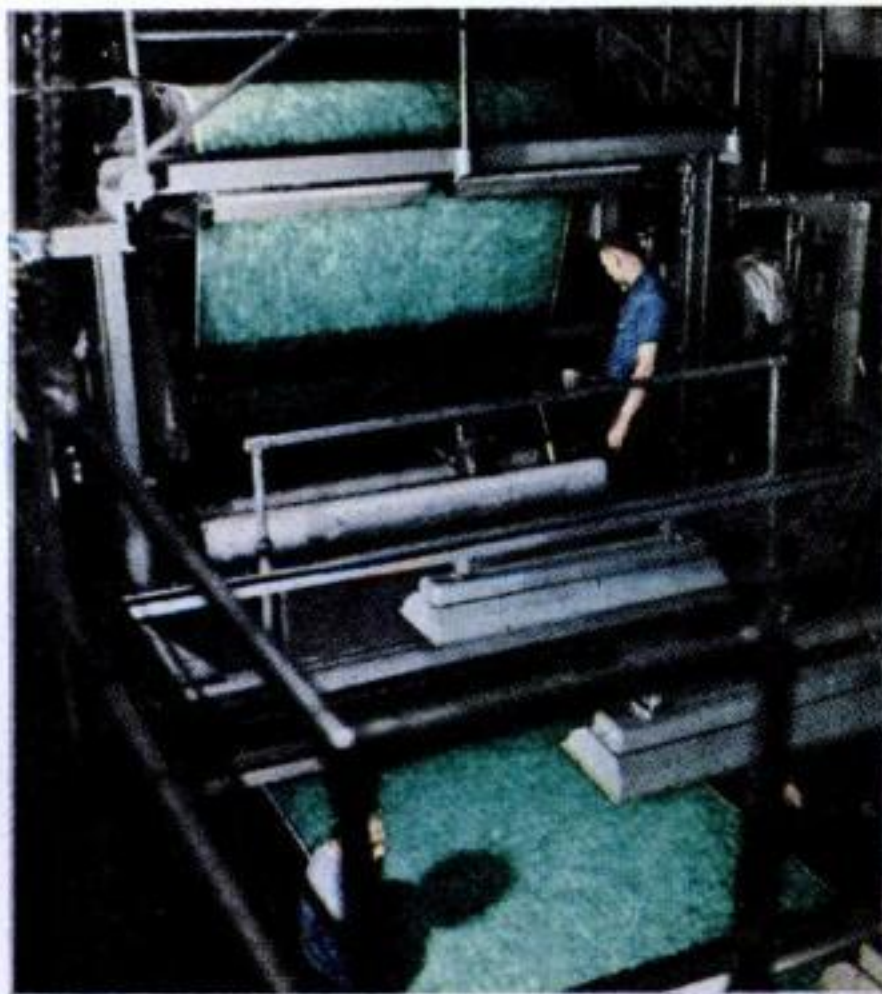
Linoleum mix. Most linoleums are made from linseed oil (center) which is oxidized, wood flour (left), pigment (front), and powdered limestone (right). Thoroughly mixed, these ingredients form the basic linoleum "batter."



Making marbled linoleum. After repeated mixing and re-mixing, the "batter" is fed into the first of two calendering machines. The thin split sheet shown emerging from machine is the result of the first rolling.



Second calendering. Here the sheets, cut into six-foot sections, are fed, one on top of another, into a second calendering machine. This forms a continuous linoleum strip.



Miles of colorful linoleum emerge from the second calendering machine. At this point in the process the endless linoleum strip meets its backing and is bonded to it under pressure.

revolving steel rollers is heated and the other is cooled. As the mix is pulled in between these rollers, it is spread to the desired thickness. And at the same time the mix is bonded to a continuous strip of felt or burlap backing.

From the calendering machine, the finished linoleum goes to one of 26 huge vault-like maturing stoves. Here it may hang up to three weeks for aging. Each of these maturing stoves can hold a festooned strip of linoleum 17 miles long!

In the heavier gauges or thicknesses, and in the darker colors, plain linoleum is known as "battleship linoleum." It is the kind you see mostly in offices and public buildings where the traffic is heavy and a tough, long-wearing floor covering is needed. Battleships, incidentally, don't use it anymore, bare steel being less combustible.

The more intricate linoleums require a more complicated manufacturing process. Let's follow a batch of linoleum mix down through the seven-story building that houses the big rotary linoleum press that turns out more complicated patterns. At the time Bill Morris and I were there they were churning out a green and white marbleized pattern.

Working down from the roof to the street level, the upper four floors are taken up with a continual mixing and remixing of the oxidized linseed oil, color pigments, wood flour, and limestone. This churning is necessary for a thorough blending of the mix.

On the building's third floor the linoleum first begins to take shape as a sheet. From the last of the mechanical mixers and blenders, the mix is fed into the first of two calendering machines that are much like the one used in the manufacture of plain linoleum.

Embossed linoleum is made by sifting powdered linoleum mixes through metal stencils cut out to form the various parts of the design. Here an inspector is checking the design.

This first rolling produces a continuous narrow strip of linoleum that is marbleized in one direction.

This strip then is automatically cut up into short sections, which are fed by hand crosswise into the second, and larger, calendering machine. The pressure and heat of this calender's rollers complete the marbleizing of the pattern. At the same time they press the sectional strips together into a homogeneous and continuous six-foot-wide ribbon of linoleum. On the ground floor, this linoleum ribbon meets the continuous strip of backing and is bonded to it with the aid of further heat and pressure.

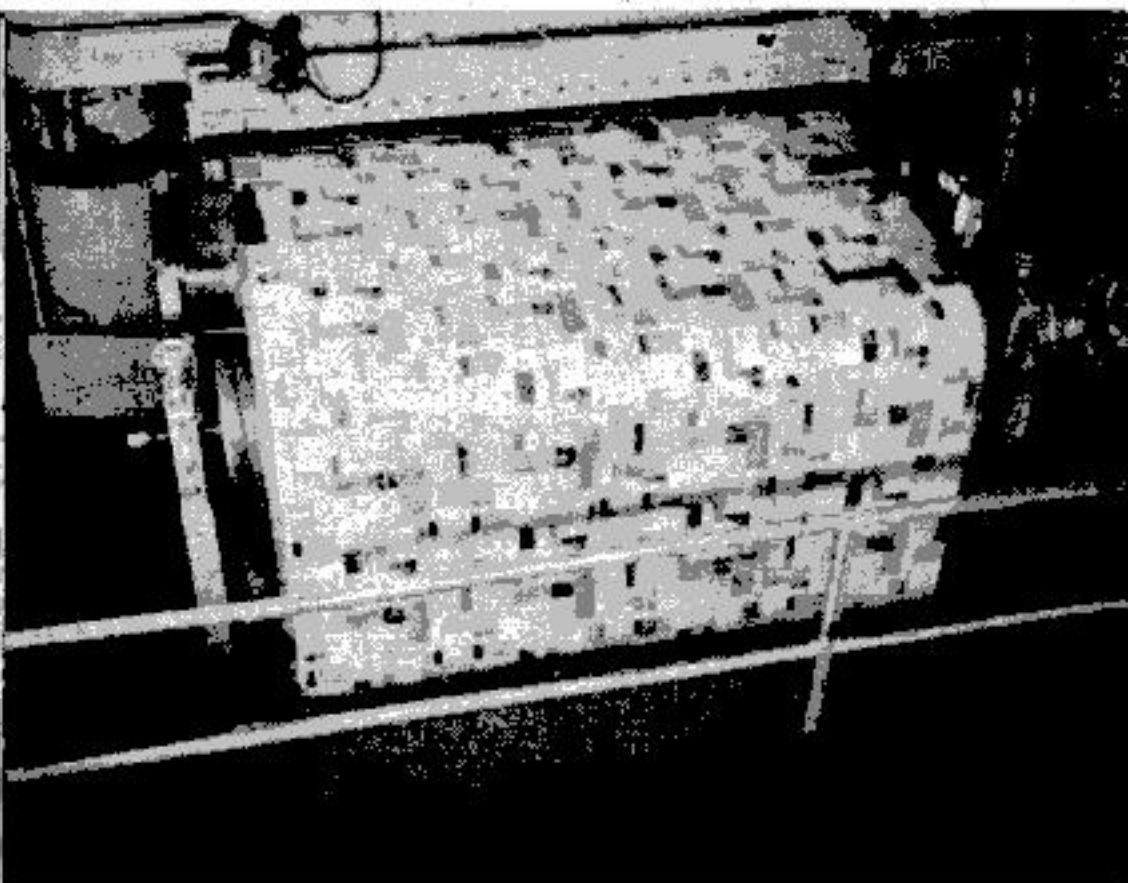
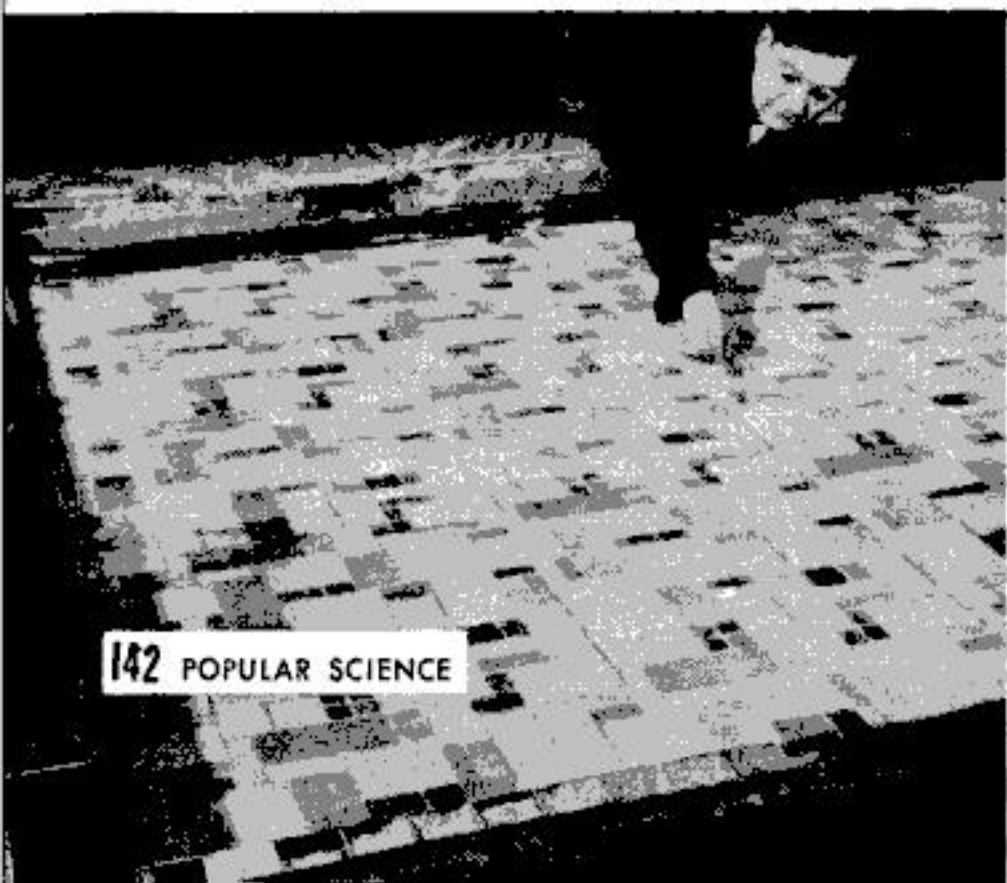
Rotary Machine Does Quick Job

By using an additional section of this huge linoleum-making machine, the complicated straight-line inlaid patterns can be made. This additional part consists of a giant drum on which automatically cut blocks and designs of the various colors are placed and fitted together like the pieces of a jigsaw puzzle to complete the over-all pattern. Years ago, this type of linoleum had to be cut and assembled by hand. Now, the rotary machine does it quickly and accurately.

Running at top speed, and on a simple design such as a marbleized pattern, this press in a very short time can turn out enough linoleum in a continuous strip to pave a straight path from New York City to Trenton, N. J., or almost enough to stretch from Cleveland, O., to Detroit, Mich.! And all this comes from only one machine in one plant turning out many different kinds of linoleum.

Another and different process is used in fabricating embossed linoleum. This type is

Pressure and heat provided by a giant hydraulic press then solidify the powdered mix and bond it to the backing. Here another press is shown pressing in the embossing.

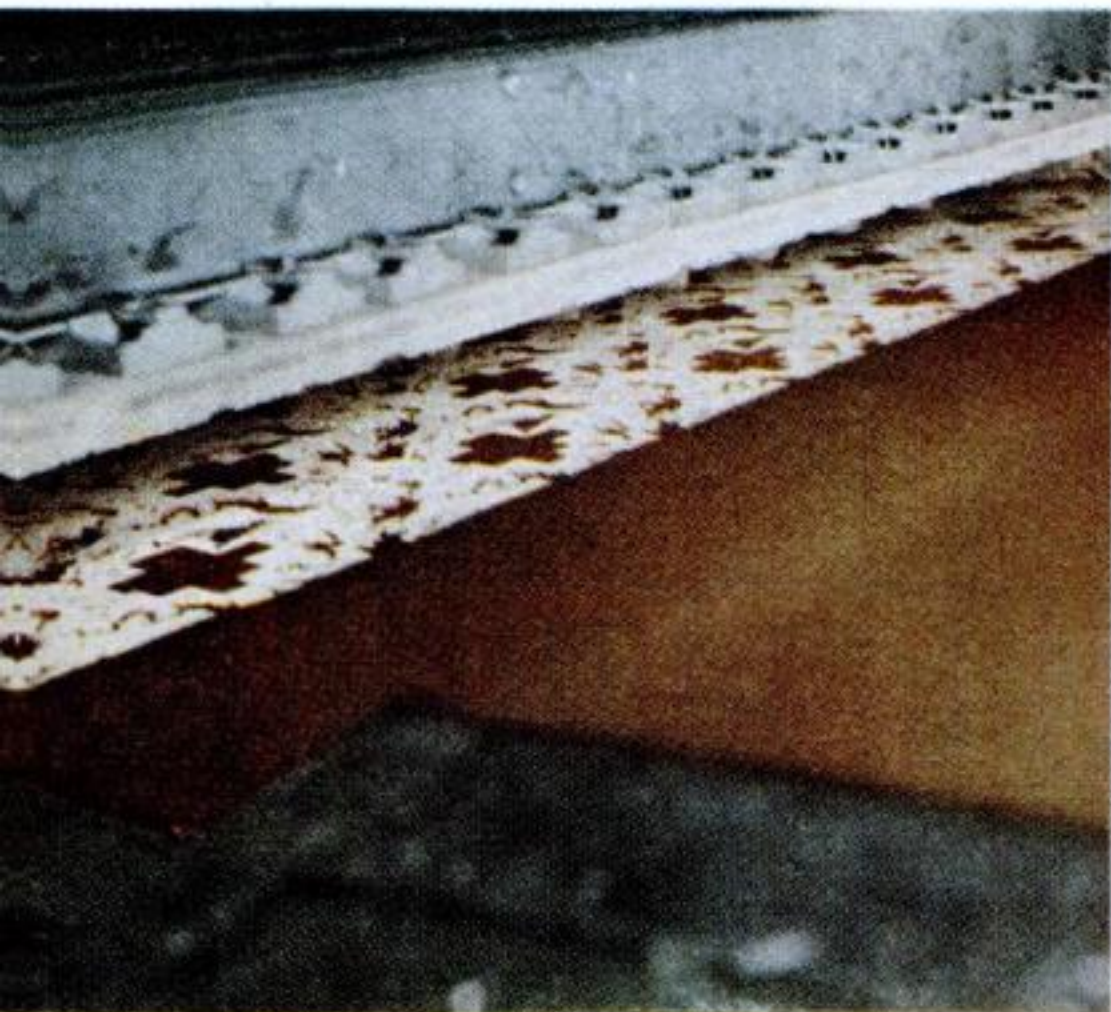




Felt-base floor covering is made by a printing process. Here a skilled workman is carving one of the many woodcuts that are used to apply the paint pattern to the felt base.



Start and finish. At the right is one of the carved woodcuts that helped to print the colorful mottled background of the finished felt-base floor covering shown at left in picture above.



Printing. In this photo, the first of a series of printing heads on which the woodcuts are mounted has applied the basic paint design to the felt that is going through the press.



Printing heads, picking up paint from individual wells, apply the colors to the felt one after the other. When the colorful design has been completed, it is dried in enormous stoves.

formed by sifting or brushing the various colors of finely powdered mix through a progressive series of metal stencils to build up the desired design as the backing material moves along a long flat bed.

The process is much like building up a multicolored picture with a child's stenciling set. Once the design is completed, the pattern in powder form is solidified by heat and tremendous pressure in a large hydraulic press. Another press, fitted with a die, embosses the pattern to provide a relief effect.

Felt-Base Is Printed

Just as making embossed inlaid linoleum resembles stenciling, the method for manufacturing the popular low-cost felt-base type of floor covering resembles printing. Specially treated felt is fed into a long flat-bed press. Here a series of printing heads, each fitted with a hand-cut wood block reproducing a part of the design, applies one color after another until the pattern is completed. The felt-base strip moves through the press in a series of stops and starts as the various printing heads pick up the colored enamel paints from rollers and then move down to print them on the treated felt surface.

In the color photographs that illustrate this article, three colors and black were used on the printing presses to produce the natural full-color effects. As many as 23 different colors can be used to build up the design in felt-base rug or sheet. When rugs are produced, they are printed in one continuous strip. They are cut into individual rugs after

Tips on Floor-Covering Care

THE best way to care for your floor coverings, whether they are the linoleum or the felt-base type, *is not to kill them with care*. Don't use strong or gritty soaps. Don't scrub them to death. The woman won't believe you, but the makers say, "the less washing the better."

Clean the covering once and for all with a mild soap. Then wax it. Give it repeated waxings at least once a week.

When you spill something, wipe it up immediately. If you keep your linoleum or felt-base well waxed, a daily sweeping or dry-mopping will keep it spotless. If this fails to remove all the dirt, wipe the floor with a damp cloth or wrung-out mop and then apply more wax. Wax, not soap, is the secret of long wear and good appearance.

being thoroughly aged in the maturing stoves.

When you watch linoleum and felt-base rugs literally roll off the lines in this big plant, you are likely to wonder where it all goes. There just can't be that many floors. Yet, it has been estimated that in 1948 the floor-covering industry of the United States will turn out at least 22,000 miles of linoleum and 85,000 miles of felt-base floor covering—without meeting the consumer demand. That's just about enough floor covering to go around the earth at the equator four times!

END

Nitrogen Shrinks Metal

IF A metal part is too big to fit into an assembly, a bath in liquid nitrogen chills it to 320° below zero F. and reduces the size. For handling small parts this way, the Linde Air Products Co. has developed the stainless steel bucket shown at right. The liquid nitrogen is contained in a well-insulated inner receptacle. The object to be treated is placed in a perforated ladle and dipped directly in the liquid bath through a hole in the wooden cover.

The process is especially recommended for such parts as valve-seat inserts, cylinder liners, and bushings where it is difficult to expand the outer member of an assembly. The company has made liquid nitrogen available in large quantities, and has developed various other machines for its use.





Aerobee Soars 78 Miles

THE Navy's latest rocket, above, set a new record for made-in-America missiles on its first trial, reaching a 78-mile altitude and a 3,000-m.p.h. speed. Called the Aerobee, it is designed to carry instruments for research into the upper atmosphere rather than for military use. The new rocket is simple and inexpensive to build, and a small crew can fire it without complex launching gear.

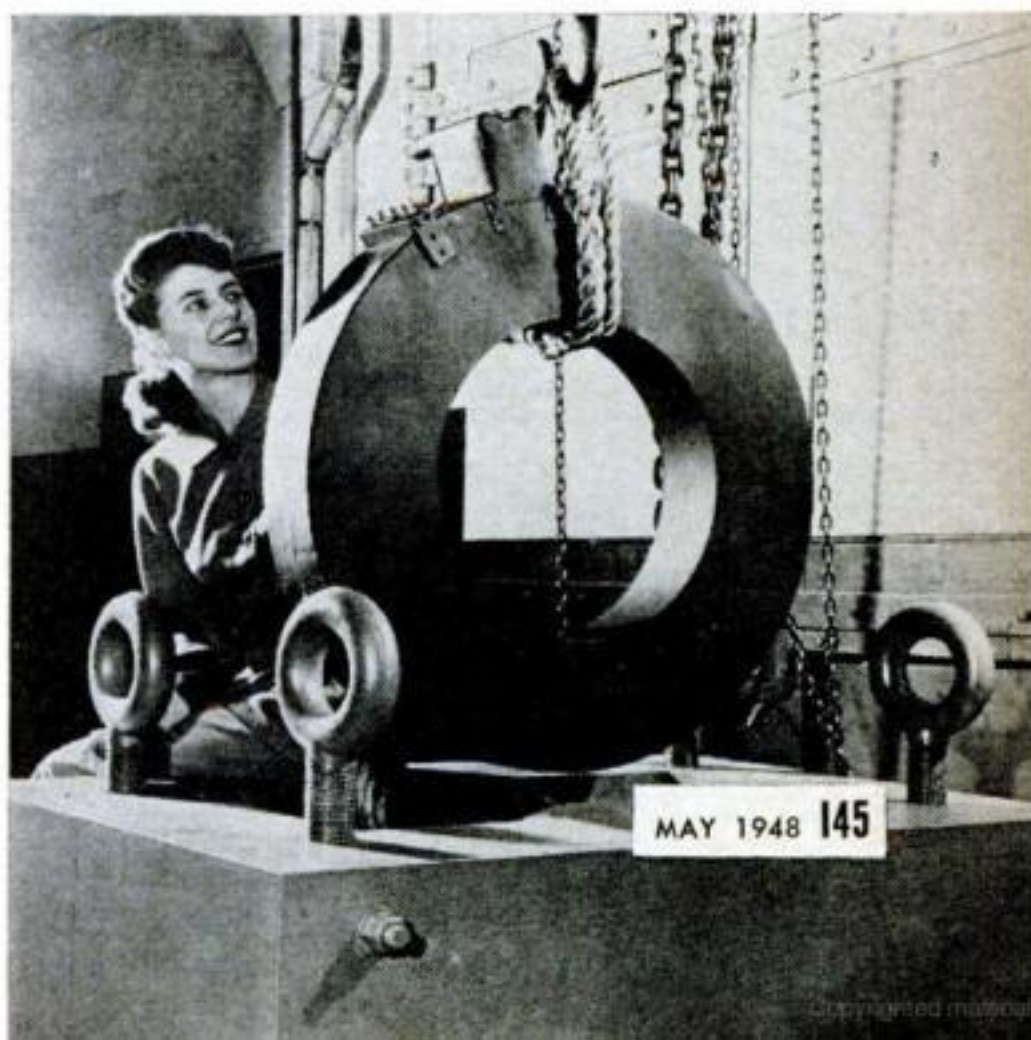


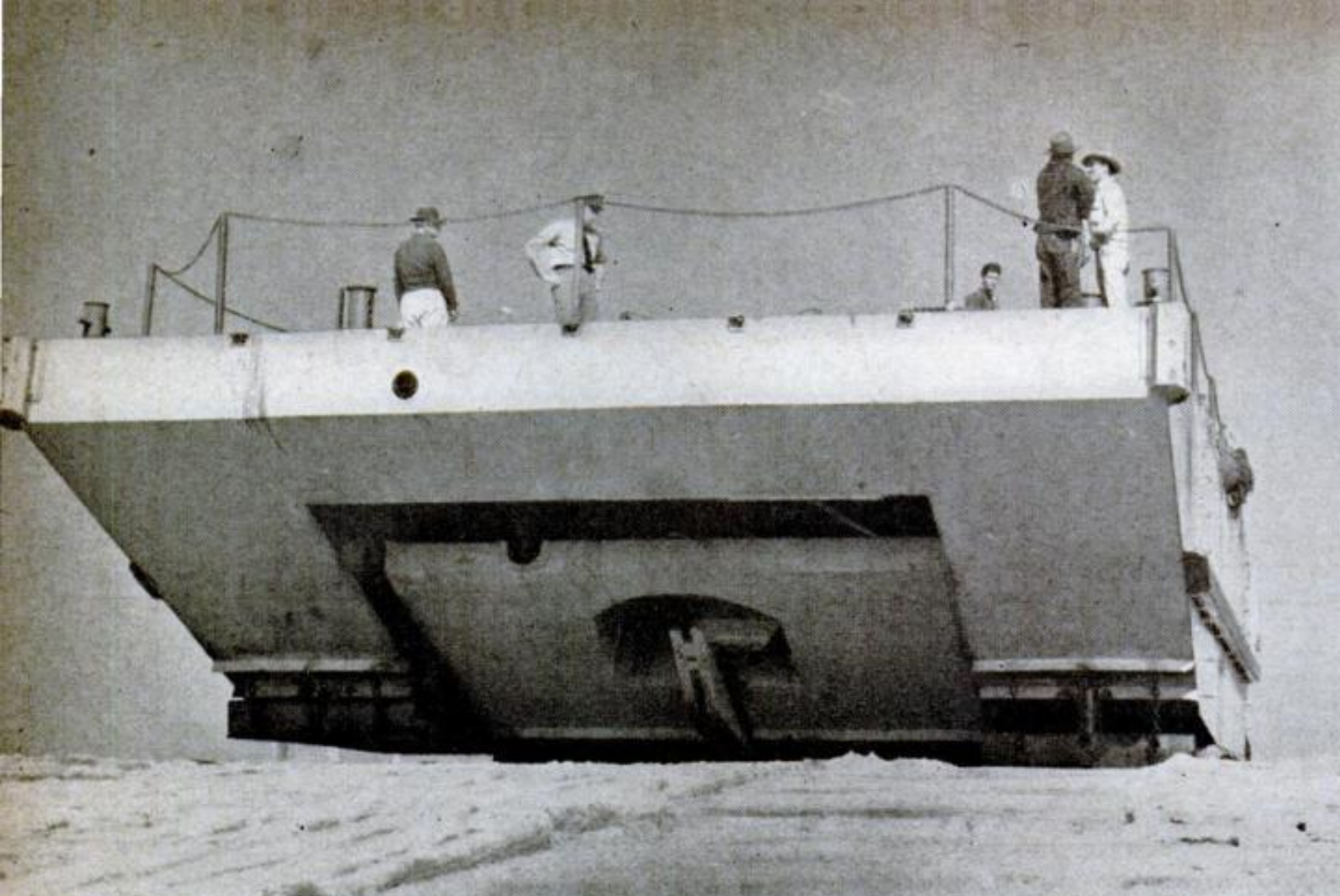
Tele Goes Movie Size

TELEVISION pictures as big as movies will soon be seen in theaters and taverns equipped with a new type of projection television system. It uses a small, very bright cathode-ray tube and a special projection lens in a ceiling-mounted unit to throw pictures as big as 6 by 11 feet on an aluminum screen. The receiver, built up of plug-in subassemblies, can be located away from the screen. It was developed by Tradio, Inc.

New Magnet Makes Cold

LARGEST and most powerful of its type, a new six-ton electromagnet will shortly be aiding low-temperature research at Rutgers University. Its strong field will actually remove heat from materials being studied under extreme cold near absolute zero, -460°F . If used for lifting, it could raise 13 automobiles, report the GE engineers who built it.





Lumbering up a beach, barge has tucked its propeller into well in center pontoon, which is

16 feet wide and 44 feet long. Outer pontoons are 6 feet wide, 60 feet long, and 9 feet high.

Leapfrog Barge Swims, Walks, Climbs

NEITHER surf nor sand dunes can stop the Navy's newest amphibious vehicle, a "walking" barge with a leapfrog gait and pontoon legs. Carrying a 60-ton load, it lifts itself by its own bootstraps over mud flats, banks, and beaches. It can even climb a six-foot wall.

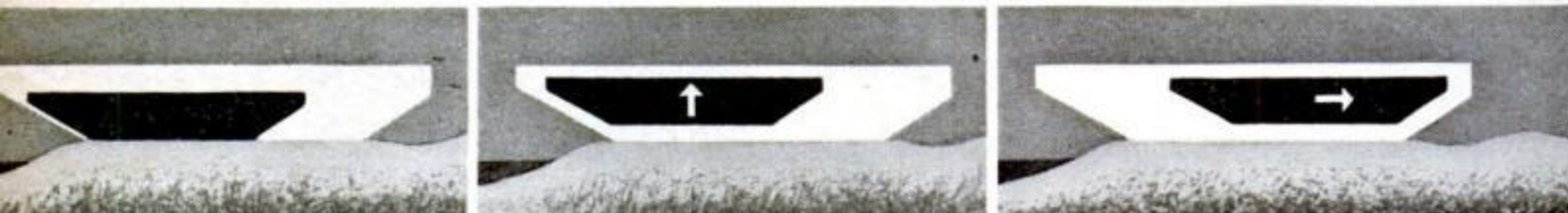
A single stern propeller, driven by a power take-off from twin Diesel tank engines, propels the barge in the water. When it reaches shore, the propeller folds up out

of harm's way, and the huge craft starts to walk on the three compartmented pontoons that form its hull. For each ponderous step, the center pontoon is lifted 17 inches and moved forward 10 feet; then the outer pontoons, which are decked over to carry the load, move upward and forward in turn, as illustrated below.

Hydraulic steering pads at the rear of the outer pontoons provide sufficient pivotal drag to turn the 60-foot barge in little more

How the barge walks: A step begins with all three pontoons on the ground, the center one in its rearmost position. The first movement raises the center pontoon—its bow lifts first, then

the stern—and the next one rolls it forward 10 feet between the outer pontoons. The driving mechanism is secret, and the barge's speed, on land or in the water, has not been disclosed.





Heading for a landing. barge shows off its broad, flat deck—ideal for speedy handling of heavy cargo. Inventor has suggested building houses on the deck for use in the Arctic.



Barge uses propeller (which can be set at various angles) as far up the shore as possible before starting to walk. Outbound, it reverses process and walks as far as it can.



Balancing act on a sand dune illustrates the barge's stability. Walking mechanism, operated by one man below decks, gives the 60-foot craft two speeds forward and one reverse.



Overhang at bow and stern enables barge to hoist itself, step by step, over obstacles like this six-foot wall, although pontoons rise only 17 inches in making a single step.

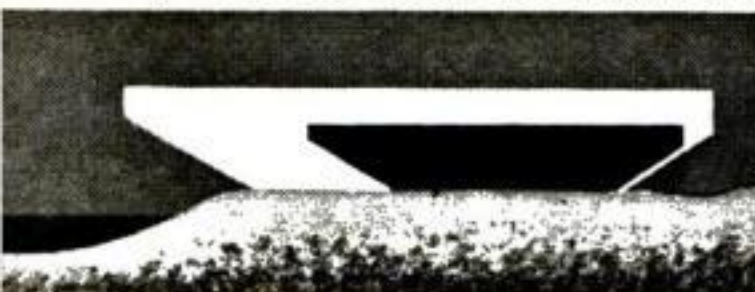
than its own length. In the present model, vertical fins in the forward sections of all three pontoons insure traction in mud.

The barge was designed by John T. Tucker, superintendent of the Navy's proving ground at Port Hueneme, Calif., where it is being tested. He believes that his steel leap-frogs, built in many sizes, may change the whole concept of amphibious landings and ease the problems of setting up military outposts at remote points.

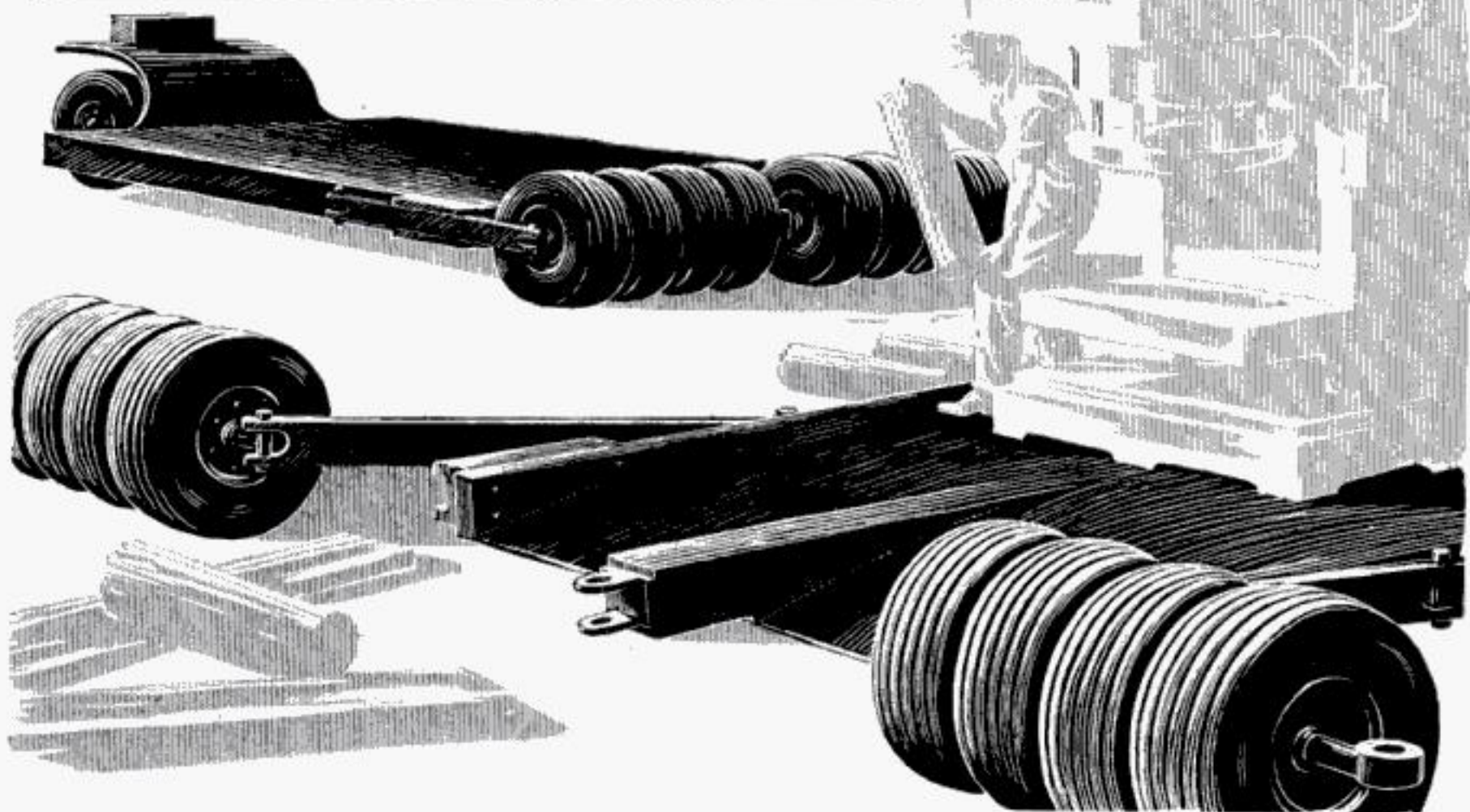
When the center pontoon reaches its forward position, it is lowered again to begin the second half of the step. Now the outer pontoons rise while the center one supports the barge's entire

The uses suggested for the craft support his belief. Carrying stacks of sectional road mats, for example, the walking barges could string completed landing ramps or airstrips behind them. They would be useful in building bridges or piers. Armored, they could become mobile fortresses to cover troops making shore assaults. In the Arctic, where impassible ice gives way to impassible bogs when the tundra melts, the barges could provide year-round, heavy-duty transport.

weight. Moved forward, the outer pontoons are ready to descend and put the barge back on "all threes" once more, center pontoon aft, ready for the next crunching step.



New Ideas from the Inventors



Trailer Sits Down. Loading would be no problem for users of the truck trailer patented by Benjamin Fitzpatrick, of Miami—it simply spreads its wheels and squats.

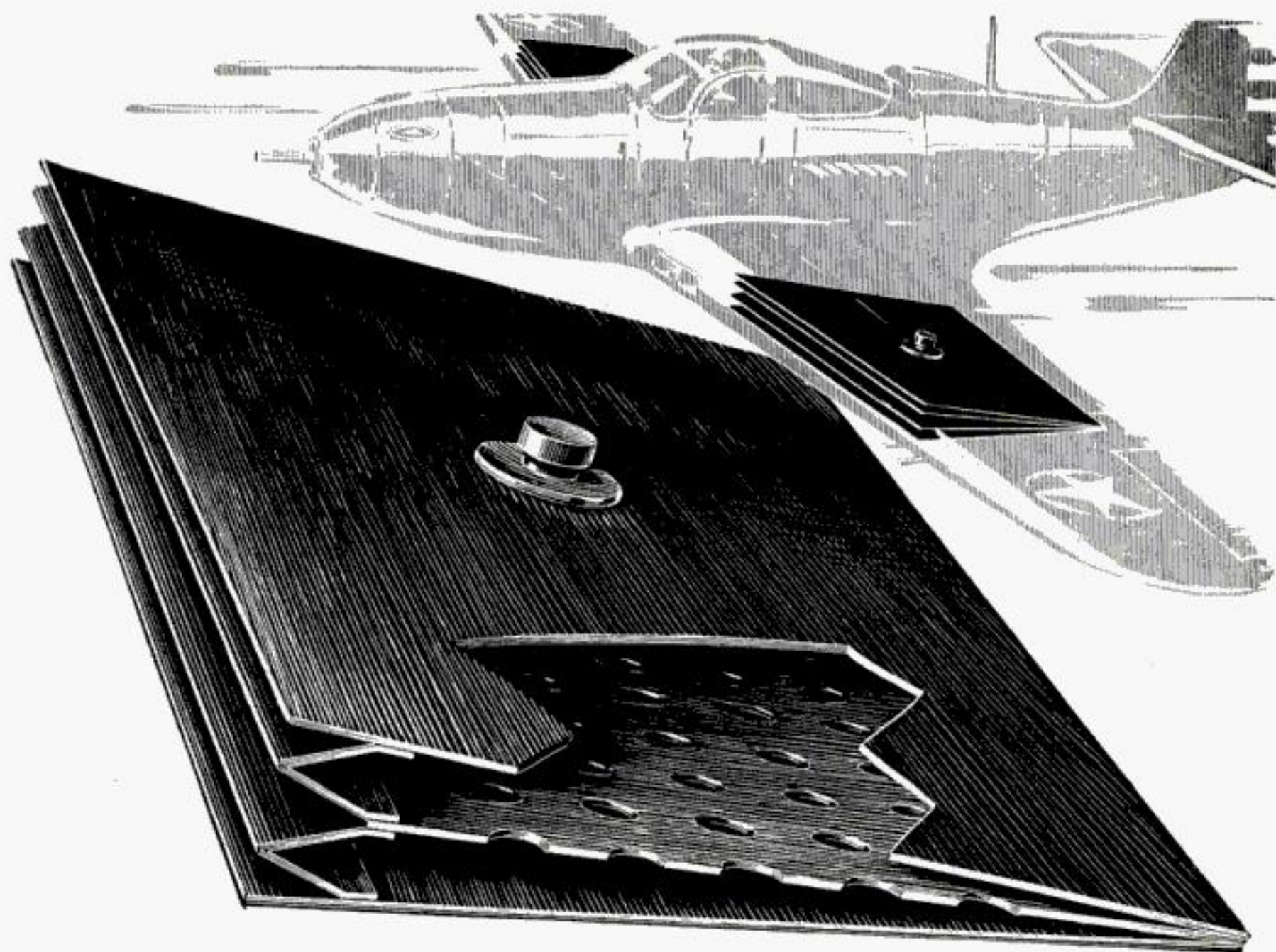
The rear end is jacked up, and the divided axle, hinged at the sides and coupled in the middle, is swung out like a double door. The trailer's end is then lowered onto the ground.



Lighted Float Lures Fish. To help entice the fish to his bait, Teddy Pope, of Memphis, has invented a float that holds a miniature battery and bulb and shines a tiny light into the water. A U-shaped guard protects the bulb from rocks and supports the bait. Another guard at top covers a switch and connects the float to the fishing line.

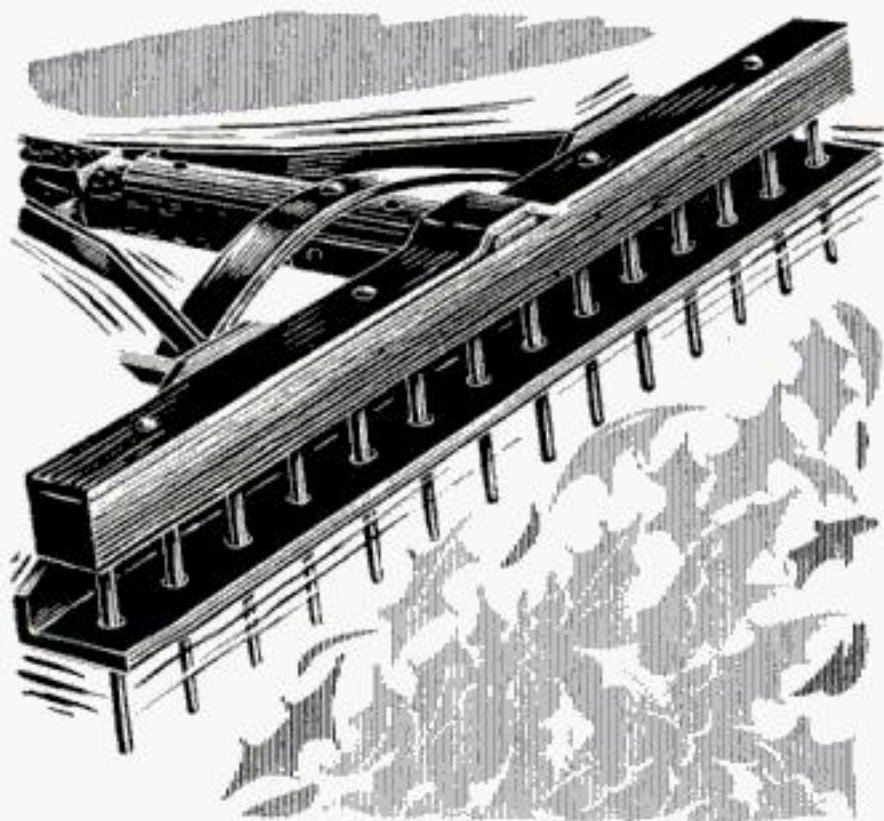


Useful Trimming for Pajamas. To keep unruly pajama pant legs pulled down neatly around the ankles without going into contortions to do it, Lillion and Anna Nahas, of Beaumont, Tex., have invented just the thing. Short straps on the bottom of the pant legs let you tuck in a toe and push each pant down with the other leg.

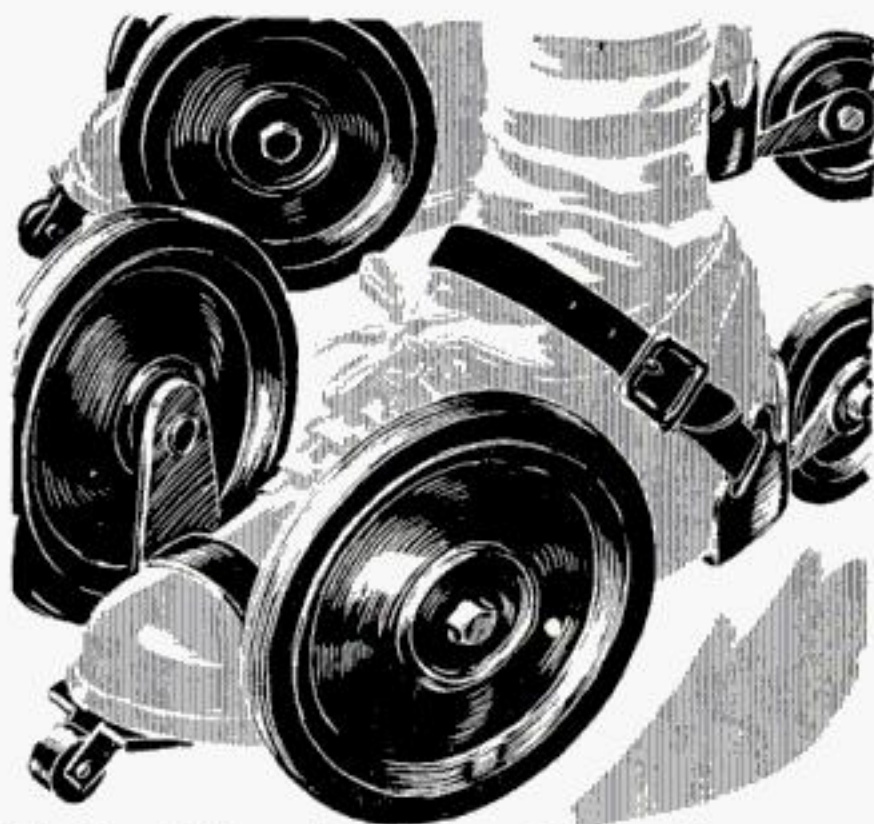


Fuel Tank Is Collapsible. This airplane fuel tank is always full. Designed to eliminate the explosion hazard of vapor in partially filled tanks, the accordion-sided

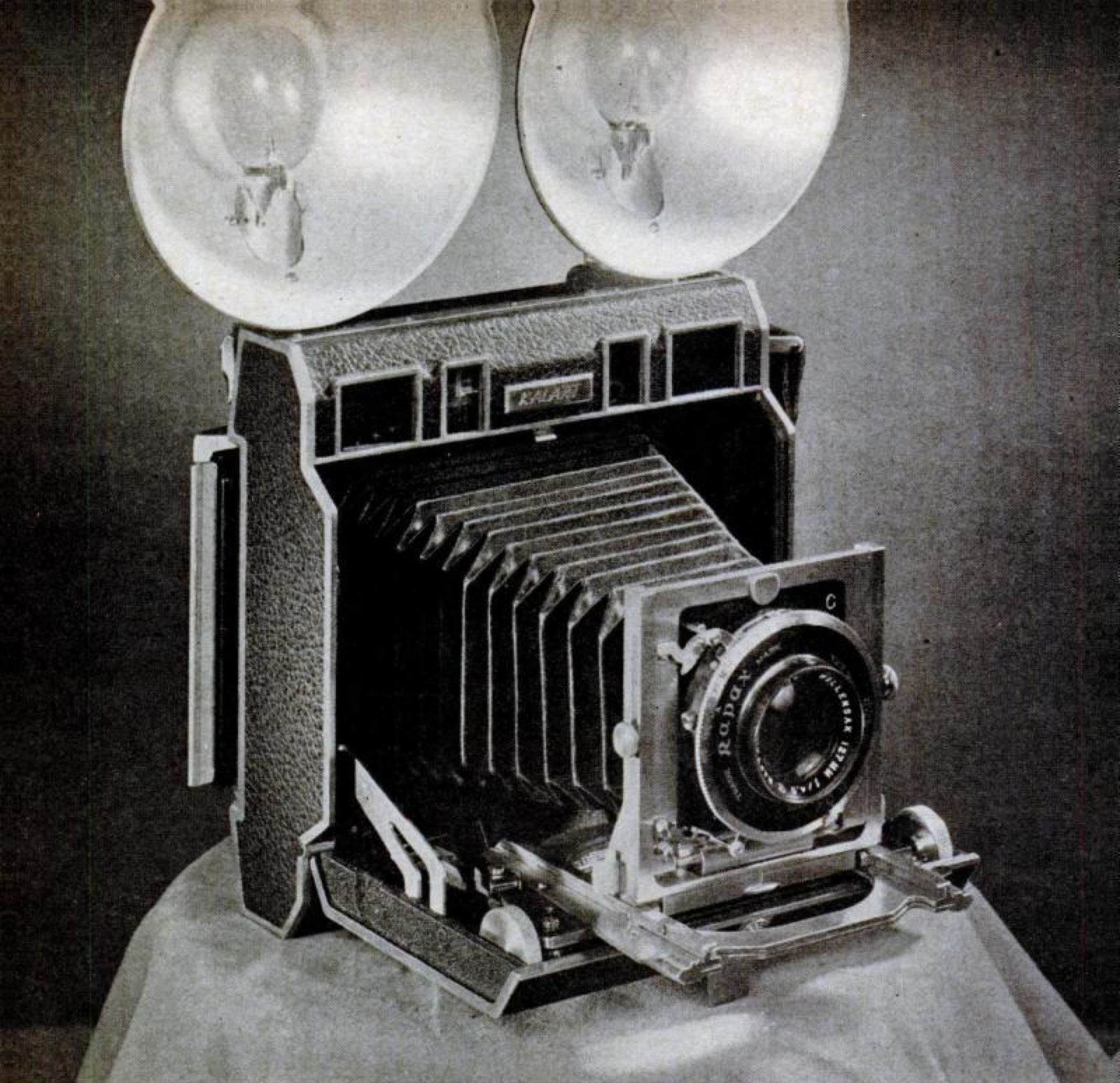
wing tank collapses under its own weight as the fuel is exhausted. The perforated plate checks sloshing of fuel. The tank was invented by Henry Lorenz, of Bayside, N. Y.



Rake Cleans Own Teeth. You wouldn't have to stop every few minutes to clean out this rake by hand. Just press a lever on the handle, and a plate slips down along the prongs, pushing off the clogged material in an instant. Let go, and a spring bar snaps the cleaner back. The inventor is William Barracks, of College Point, N. Y.



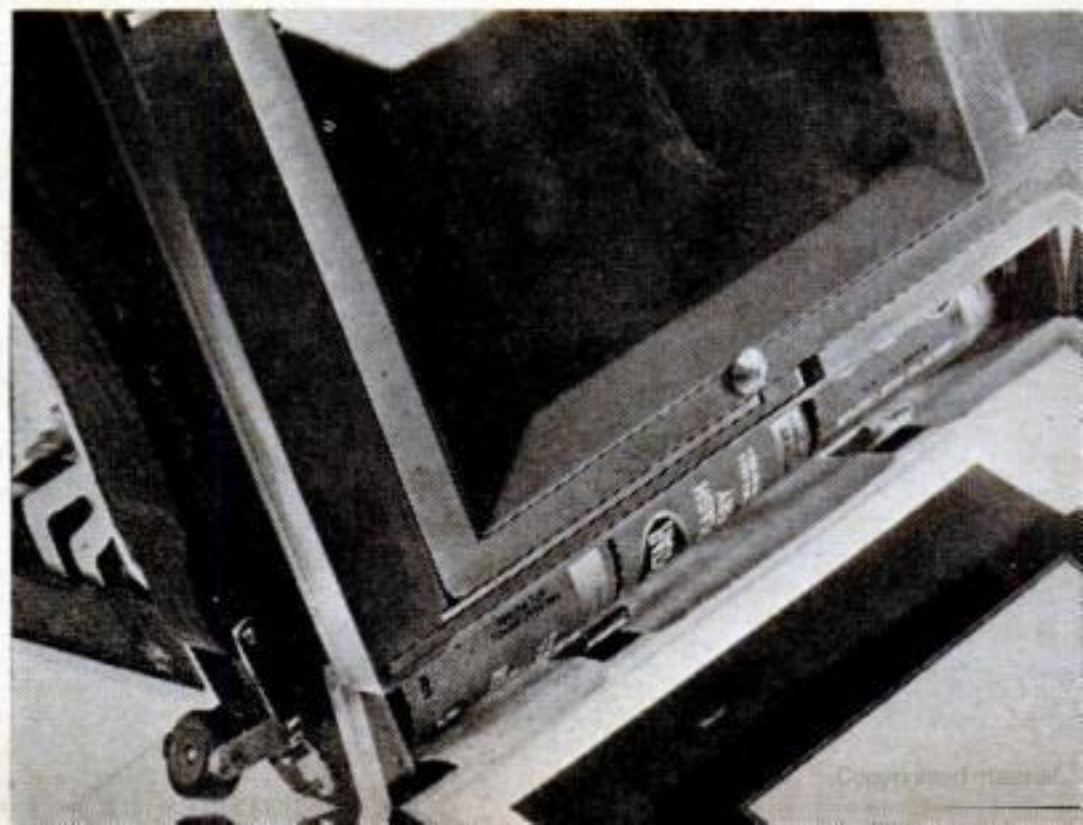
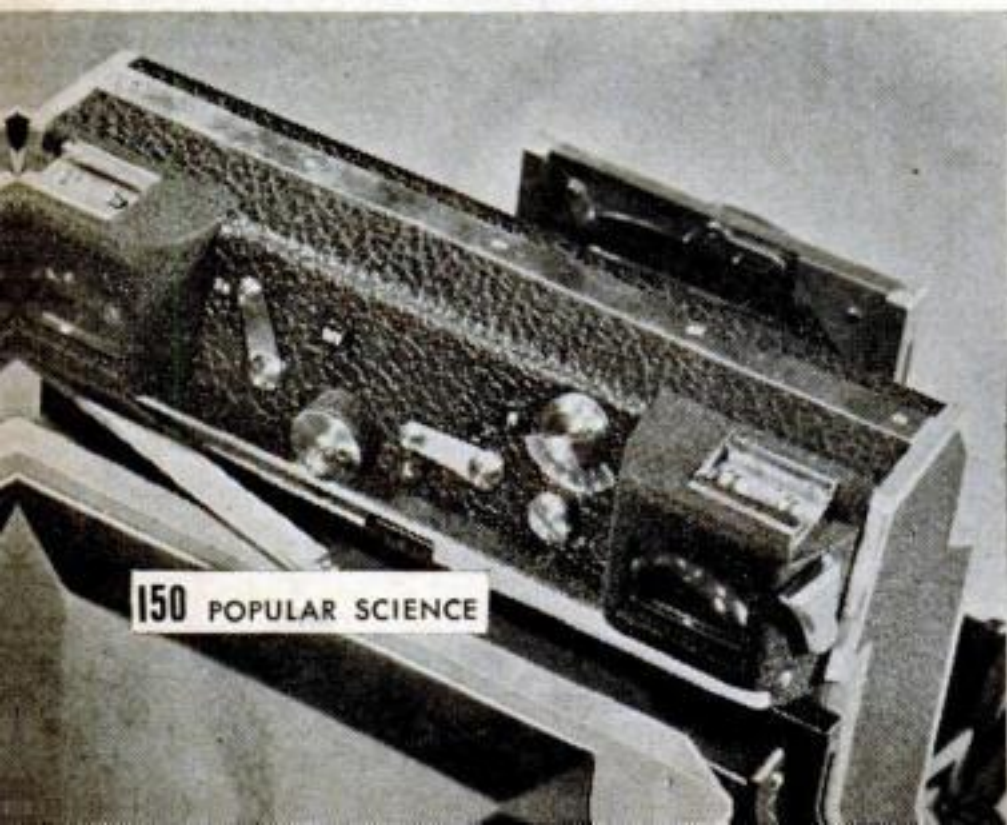
New Wheels for Old Skates. Large side wheels, supporting the ball of the foot, give these novel roller skates a low center of gravity and a pivot point for easier turning. Smaller toe and heel wheels let the skater rock his weight back and forth on the large ones without taking a header. The inventor is Arnold Vincent, of New York City.



Body of the new Kalart camera is made of lightweight, die-cast aluminum and stainless steel.

Twin range finders and view finders shown here allow use of best eye. On-off switch is for Focuspot®. The "L" and "R" switch determines which of the two windows is in use.

Standard batteries for operating Focuspot and solenoid, and for flashing bulbs are housed in recess as shown at bottom of picture below. Outlet at left is for plugging in extension flash.



This Camera Can't Go Wrong

By Hubert Luckett

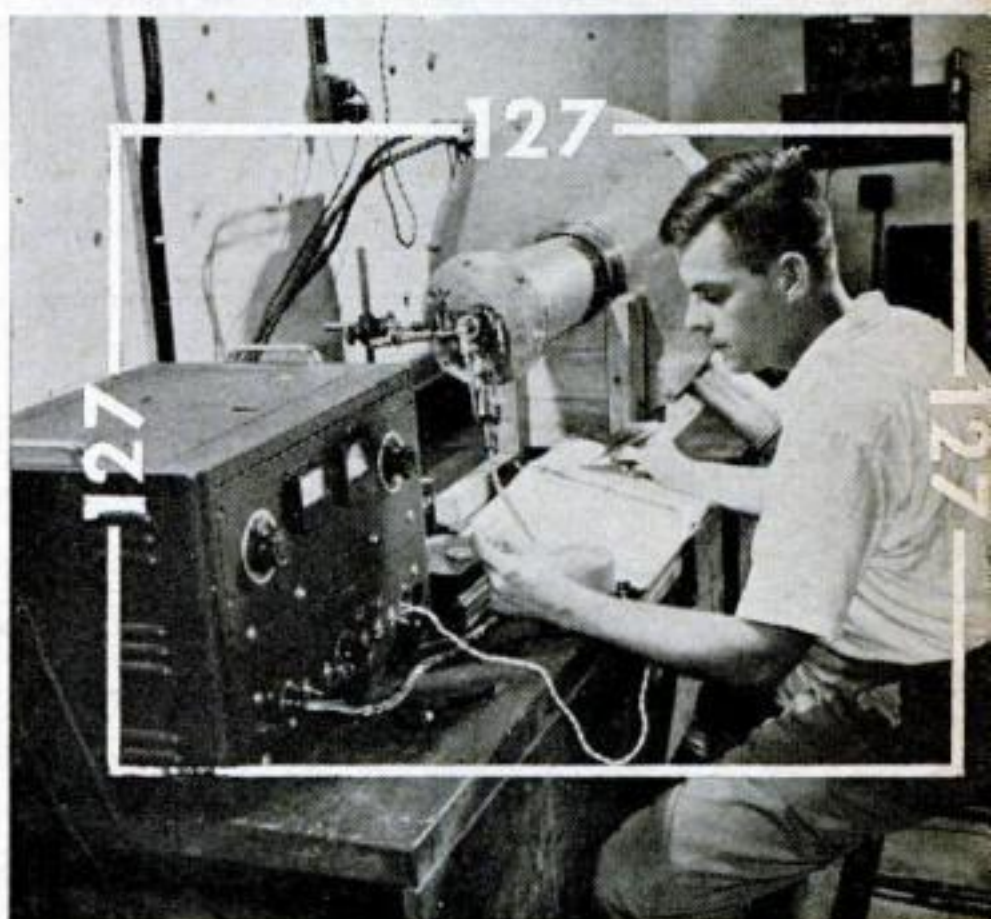
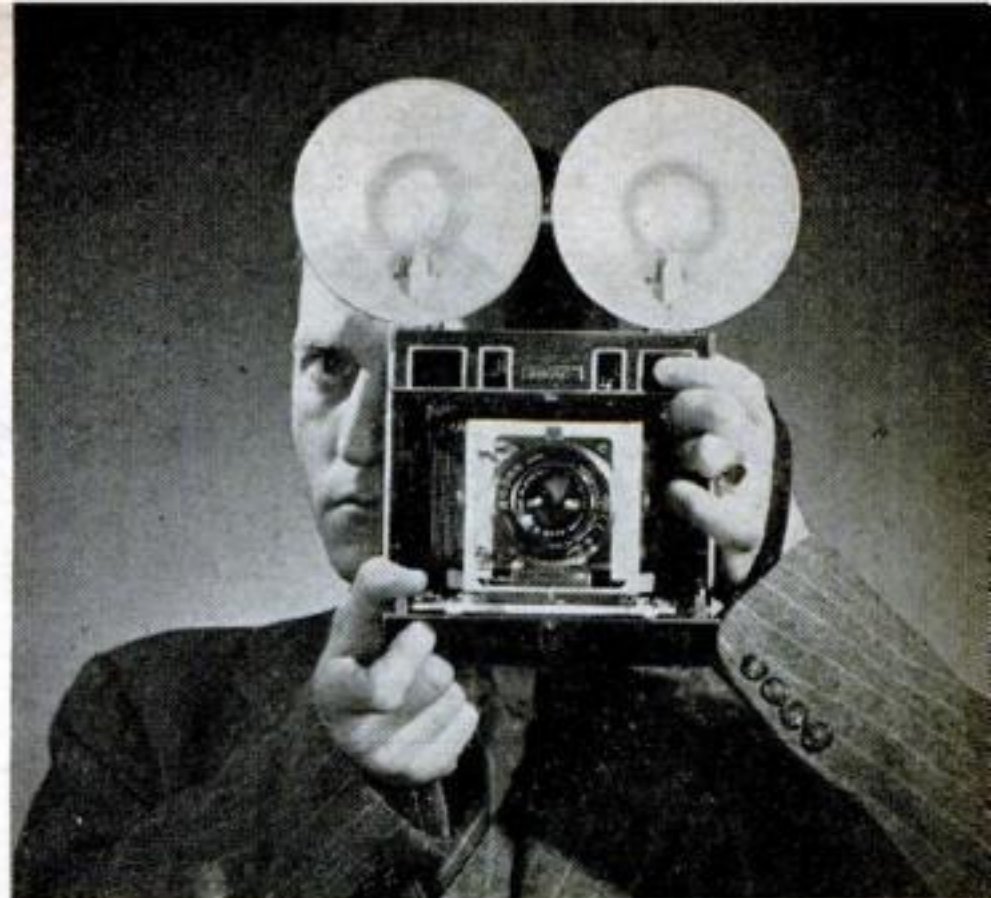
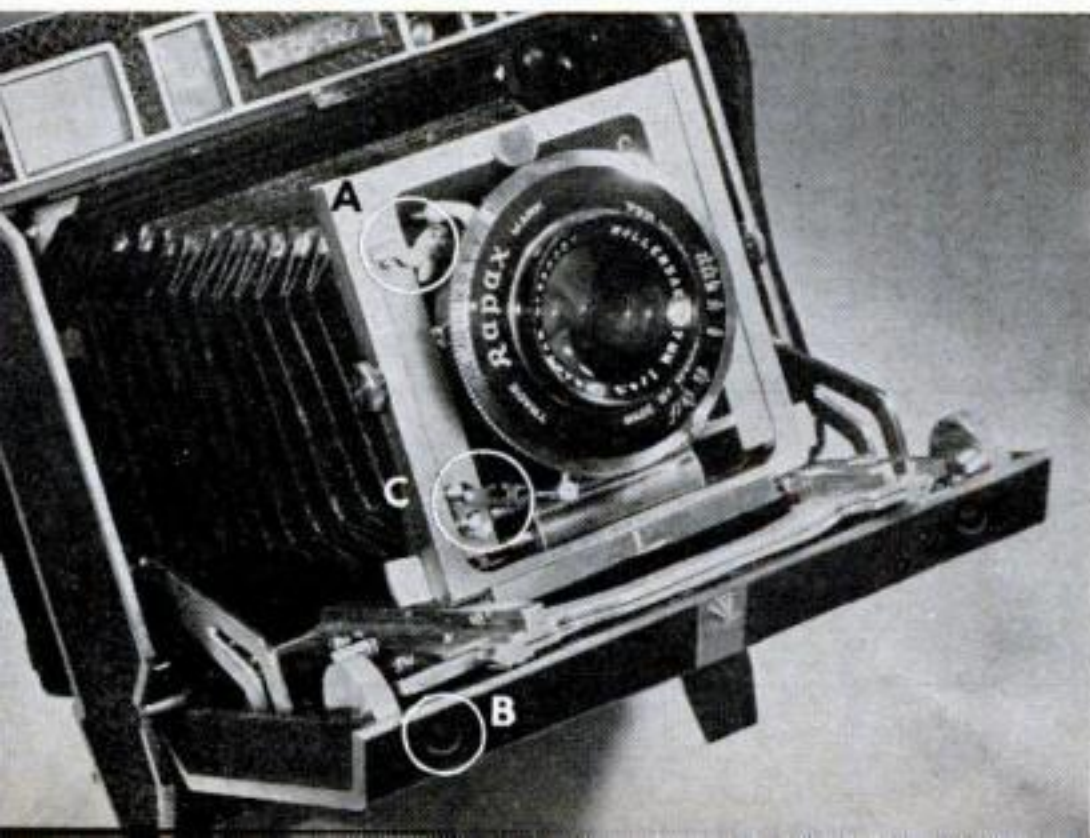
HERE'S a camera that does its best to keep you from missing that vital shot. You can't trip the new Kalart's shutter without having put in a film holder and withdrawn the slide. You can't fire a flash bulb without having cocked the shutter. You can't change the focus without knowing it.

Yet there are no accessories tacked onto this Rolls-Royce of cameras. These safety devices are built right into it. So are the range finder, view finder, synchronizer—even the batteries and all the necessary wires and links.

The lens board permits easy interchange of lenses and provides vertical rise and horizontal shifts. The solenoid shutter tripper, permanently fixed to the camera bed, serves any lens that may be used. And since most people have better vision in one eye than the other, the camera has dual range-finder and view-finder windows, as well as dual shutter releases. The range finder permits extremely close focusing and also has a Focuspot \odot for correct focusing in poor light. The camera takes 3½-by-4½ film, in either standard film holder or a film-pack adapter.

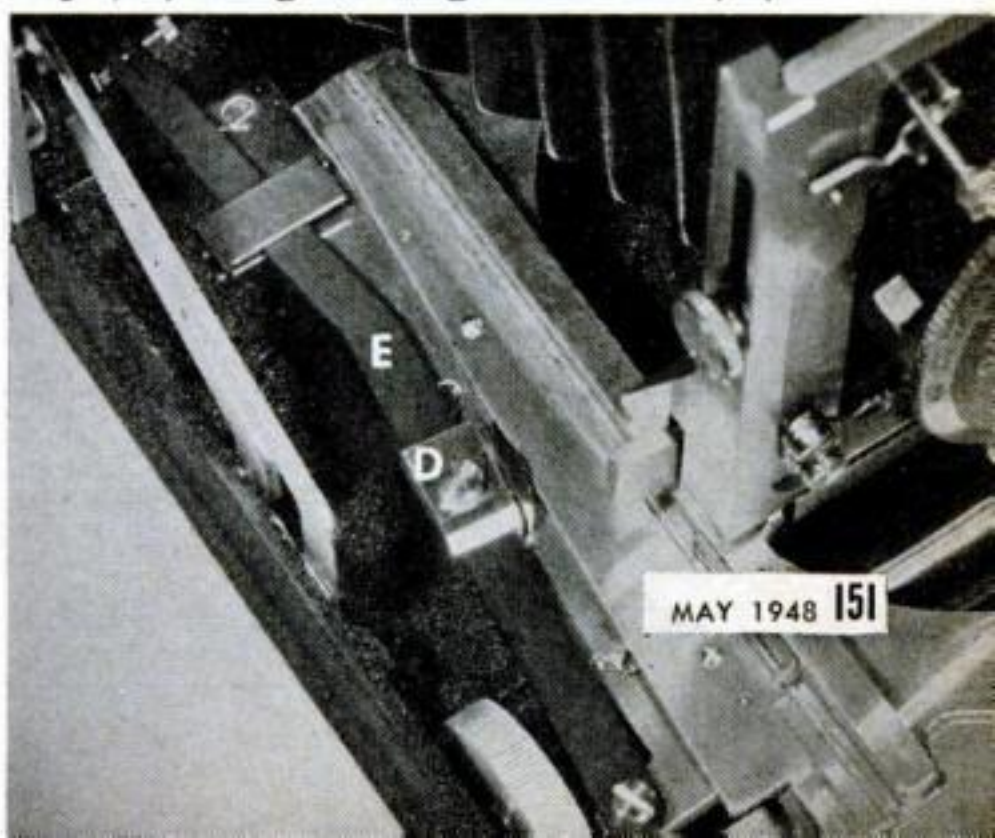
It will sell for about \$400. You'll probably be able to get one late this year.

Safety switch (A) at top left of lens board is controlled by shutter-cocking lever next to it. Other features shown are release for self-locking focusing device (B), and solenoid linkage (C).



First the range finder is used with one eye closed. Then, without shifting from the window, the eye is opened (top picture) and you see the exact area that will be in the picture. Through an optical illusion this section of the actual scene, full size, will appear to be outlined by a luminous frame as shown in bottom photo.

A wedge running the full length of the camera bed operates the range-finder mechanism. It is easily adjusted for different lenses by moving stop (D) along the range-finder arm (E).





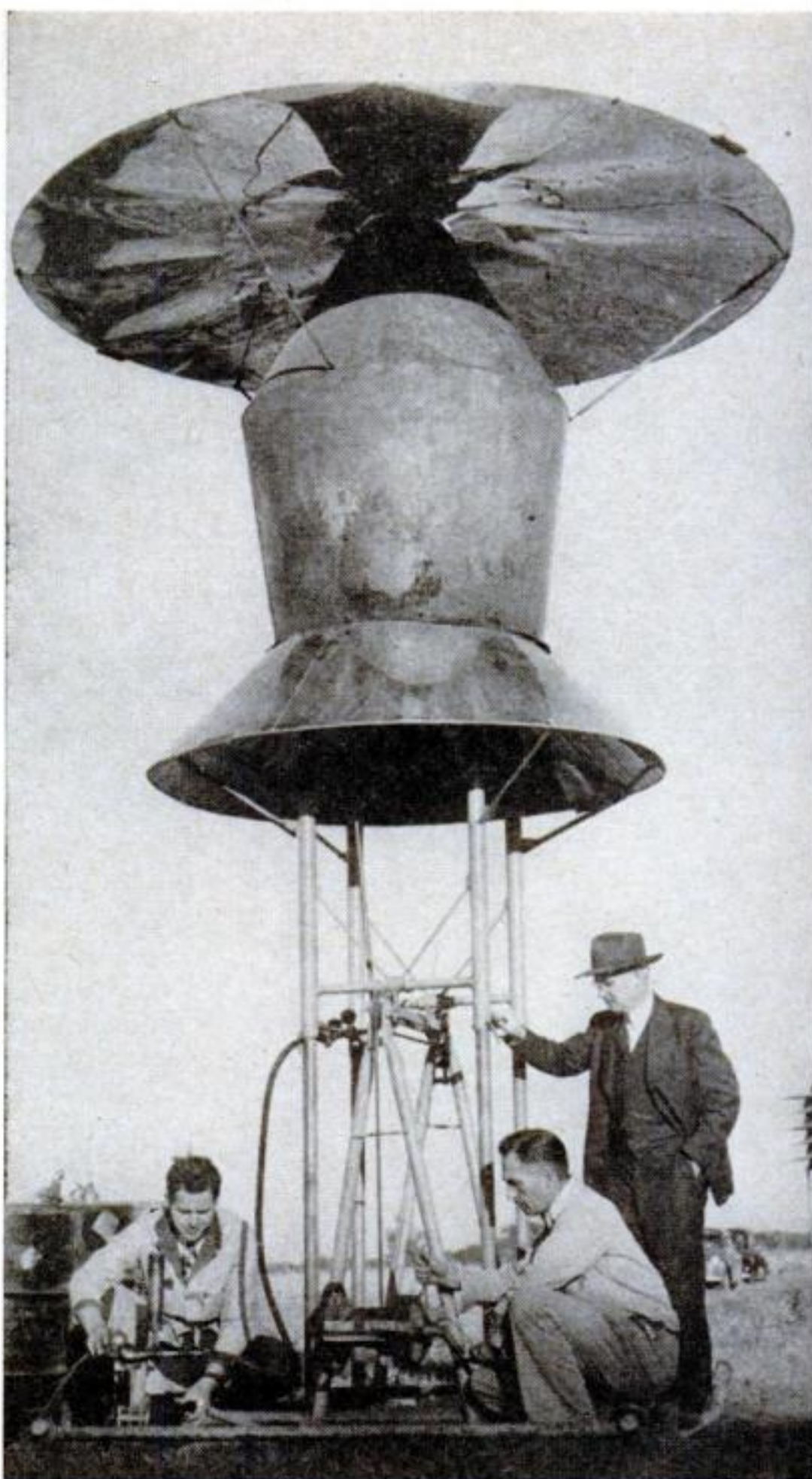
Inventory Speeded Up

THE man with the microphone is taking inventory the modern way. As he checks stock at the Naval Shipyard, Norfolk, Va., he calls off the items. These are registered on the magnetic wire recorder shown at lower left, and later transcribed on a master sheet. During a speed test using the new system, 100 items were counted in 15 minutes, as compared with 400 items a day for the old two-man-team inventory method.



Locos Get More Light

THE twin "eyes" bugging out from the front of this Iron Horse are new and more powerful locomotive Sealed Beam Ⓢ head-lights developed by General Electric. Two 200-watt, 30-volt lamps, throwing a beam of 400,000 candlepower, replace the old-type single 250-watt lamp. In case one lamp fails, the other still gives ample light.



Furnace Fights Frost

THIS pagodalike projector will protect crops from moderate frost within a radius of more than 100 feet. The structure houses a unit that burns oil under high pressure to throw off invisible infrared rays. During one experiment, the machine radiated more than three-quarters of a million B.T.U. of heat an hour. It held plant temperatures inside the test area at 37° F., although outside temperatures dropped to 29°.

Developed by Michigan State College engineers, the "Frost Fighter" Ⓢ will soon be made available to farmers for protection of high-value crops. It will be manufactured by the Evans Products Co., of Detroit.



Tossed out to clear plane's stabilizer, a husky starts down. Static line trips back-pack 'chute.

Huskies Hit the Silk



Paradogs seem to enjoy the drop. Once down, they know enough to jump on 'chutes to keep ground winds from pulling them about. 'Chute harness becomes a sled harness on the ground.

FOR rescue expeditions in the Arctic, where every mile is an ordeal, the Air Transport Command has combined the old and the new—dog sleds and airplanes. Dropping a dog team by parachute, along with a sled, dog handler, and doctor, brings quick aid to crash survivors who might otherwise have a long and painful—possibly fatal—wait. These pictures of airborne huskies were taken during a Labrador demonstration.



Doctor and dog handler hitch up team after the drop. Sled carries crash victims to nearest cleared area, where ski-equipped plane can pick them up for a quick flight to a hospital.



Dr. Percy W. Bridgman, Hollis Professor of Mathematics and Natural Philosophy at Harvard, has produced the mightiest squeeze in the world.

The Man Biggest

Bridgman's high-pressure machines strengthen guns, may one

By Herbert Yahraes

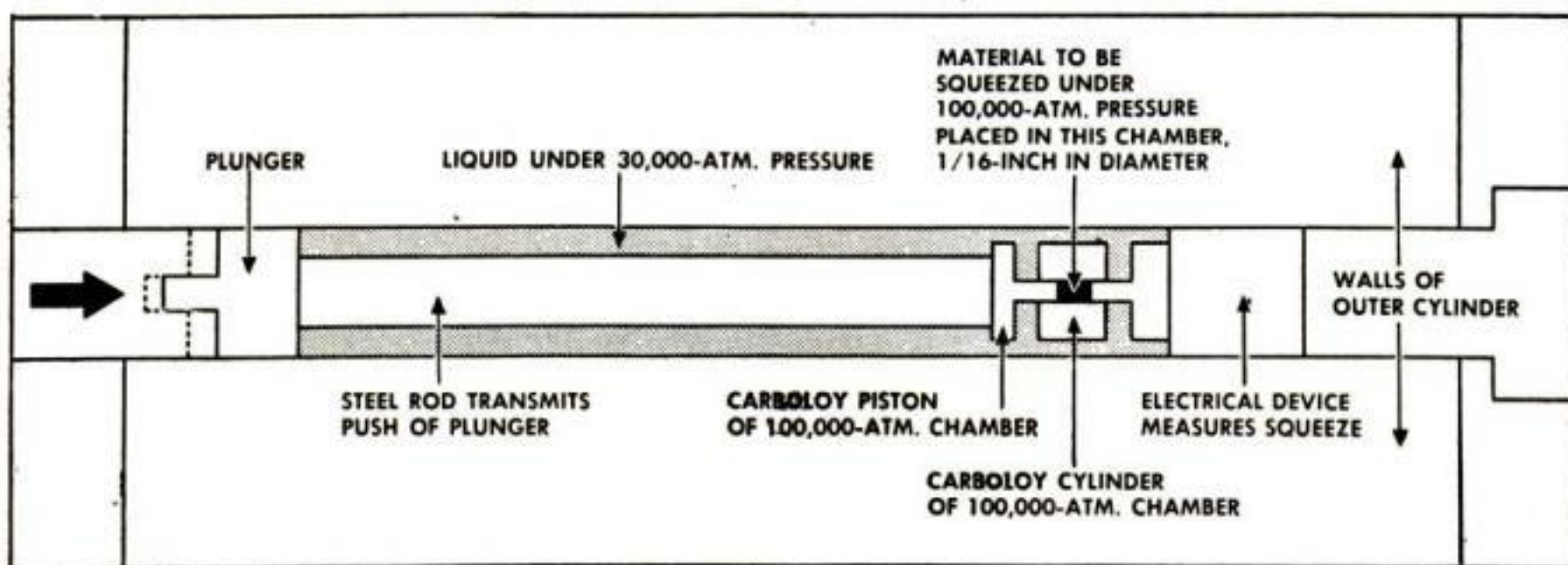
IN THIS high-pressure world, the man who puts on the biggest squeeze is mild, elderly Professor Percy Williams Bridgman, of Harvard. He bears down with pressures that create hot ice, glassy oil, ductile steel, and plastic rocks, and that, in at least one element, crack the atom.

His pressures are so great that they are measured not in the usual engineering terms of pounds per square inch but in atmospheres. One atmosphere is a little less than 15 pounds per square inch, the pressure of the earth's atmosphere at sea level. Gasoline is cracked at several hundred atmospheres; the pressure at the bottom of the deepest sea is 1,000 atmospheres; and the explosive force

inside of a big gun is 3,000 atmospheres.

But Bridgman habitually works with pressures up to 100,000 atmospheres—equal to a 750-ton flatiron squeezing an area as big as the end of your thumb. Recently he has reached the unprecedented pressure of 425,000 atmospheres. This is more than one-tenth the pressure at the center of the earth, where geologists believe that even molten iron may turn solid. Experiments leading up to it indicate that some day Bridgman, or some other high-pressure physicist, is going to make an especially precious find—how to synthesize diamonds.

As a pure scientist—and a Nobel prize-winning one—Bridgman ventures into dark territory, not knowing what he will find, and not caring whether his findings will be im-



This machine inside a machine has achieved a pressure of 100,000 atmospheres. Liquid in outer cylinder is first raised to 30,000-atm. pressure by pushing in plunger at left. In turn,

pressure of liquid helps keep walls of inner cylinder from bulging as plunger continues, pushing in pistons of inner cylinder to produce 100,000-atm. pressure in the tiny innermost chamber.

with the Squeeze

have already shown how to
day teach us to make diamonds.

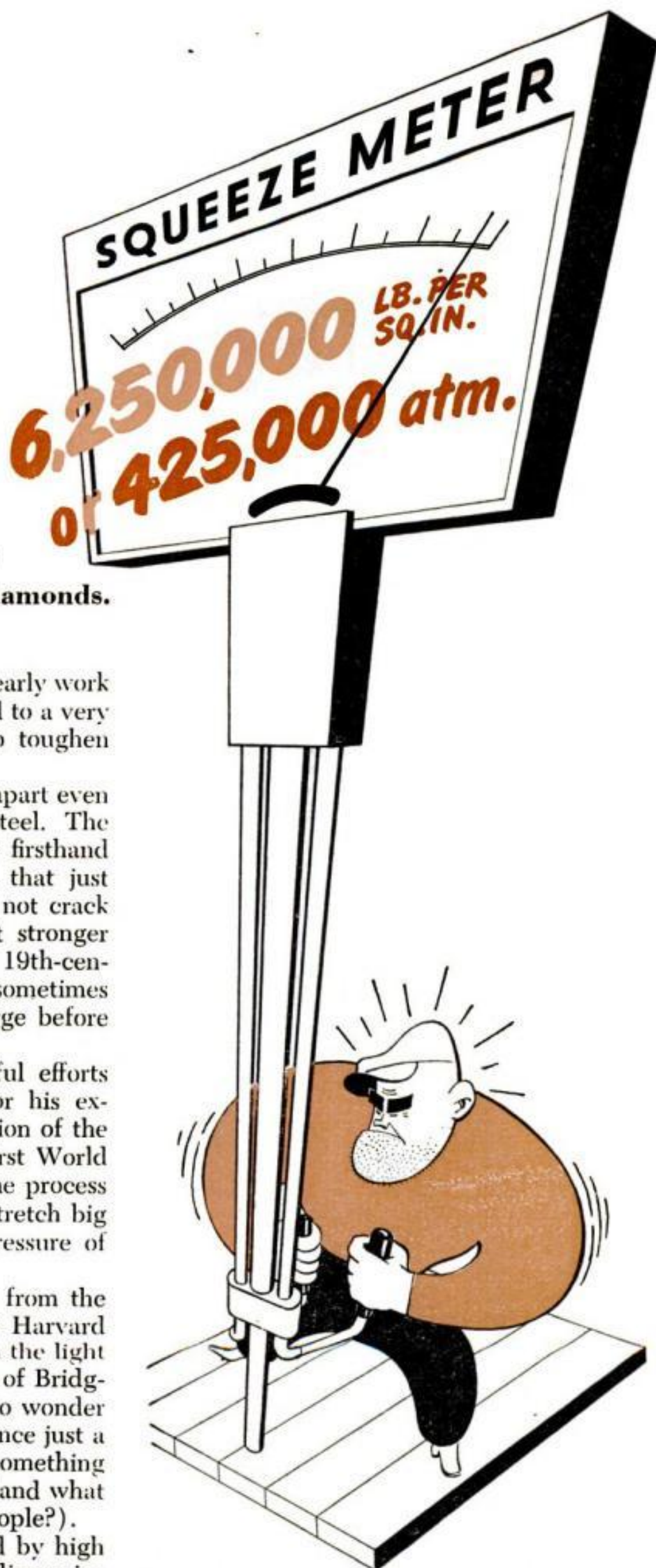
mediately useful. But Bridgman's early work with high pressures has already led to a very practical by-product—a method to toughen the barrels of big guns.

Terrific inside pressure will rip apart even a cylinder made of the toughest steel. The Harvard physicist learned that by firsthand experience. But he learned, too, that just the right amount of pressure will not crack but stretch the steel and make it stronger than ever. The idea wasn't new: 19th-century gun-makers had applied it—sometimes disastrously—by firing a huge charge before finishing the barrel.

But it was Bridgman's successful efforts to get nonrupturable cylinders for his experiments that attracted the attention of the Army and the Navy during the first World War. And now autofrettage, as the process is called, is used fairly widely to stretch big guns up to five percent with a pressure of from 6,000 to 7,000 atmospheres.

What practical results will flow from the newer and bigger squeezes in the Harvard laboratories remains to be seen. In the light of what we know at present, many of Bridgman's findings are just something to wonder at—as Volta's electric battery was once just a curiosity, and nuclear fission just something that told us more about the atom (and what had atoms to do with ordinary people?).

Among the curiosities uncovered by high pressures are new kinds of ice. Ordinary ice is a curiosity in itself—lighter, unlike other frozen fluids, than the liquid it came from. But under a pressure of 2,000 atmospheres,



High Pressure Pete. imaginary inhabitant of Dr. Bridgman's high-pressure machine, has a 425,000-atm. squeeze. One atmosphere equals air pressure at sea level—about 14.7 lb. per sq. in.



High Pressure Pete pushes out the barrel of a big gun from within. In a process called autofrettage, high pressures toughen the gun's steel barrel by stretching it up to five percent.

this ice is transformed into a variety that is denser than water. At 3,500 atmospheres this breaks down into still another kind of ice, and at 6,400 this variety gives way to still another. Altogether, six new kinds of ice have been found by high-pressure physicists, and the 40,000-atmosphere one melts only at the temperature of melting solder.

Some materials become brittle under pressure; others become ductile or even viscous—stirry. Machine oil, for instance, gets glassy. Phosphor bronze, as brittle as glass under ordinary conditions, becomes ductile under high pressure. And tiny sapphire rods, used as nozzles for rayon-spinning machinery because they are a good deal harder than

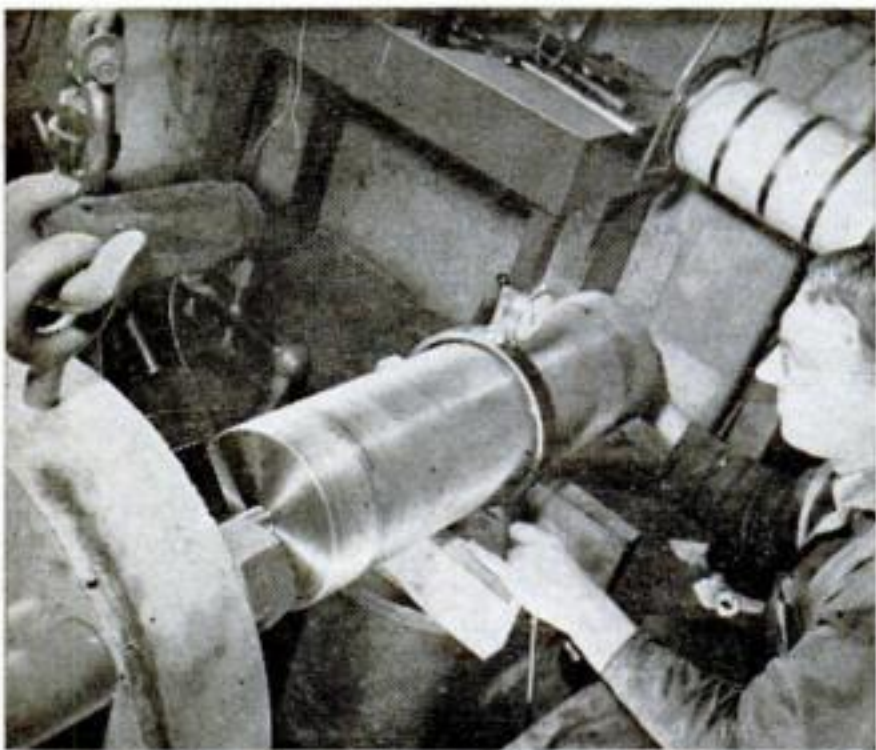


Even an atom has cracked when High Pressure Pete jumped on it. The element caesium collapsed when put under 50,000 atmospheres—one of its electrons had been forced to move.

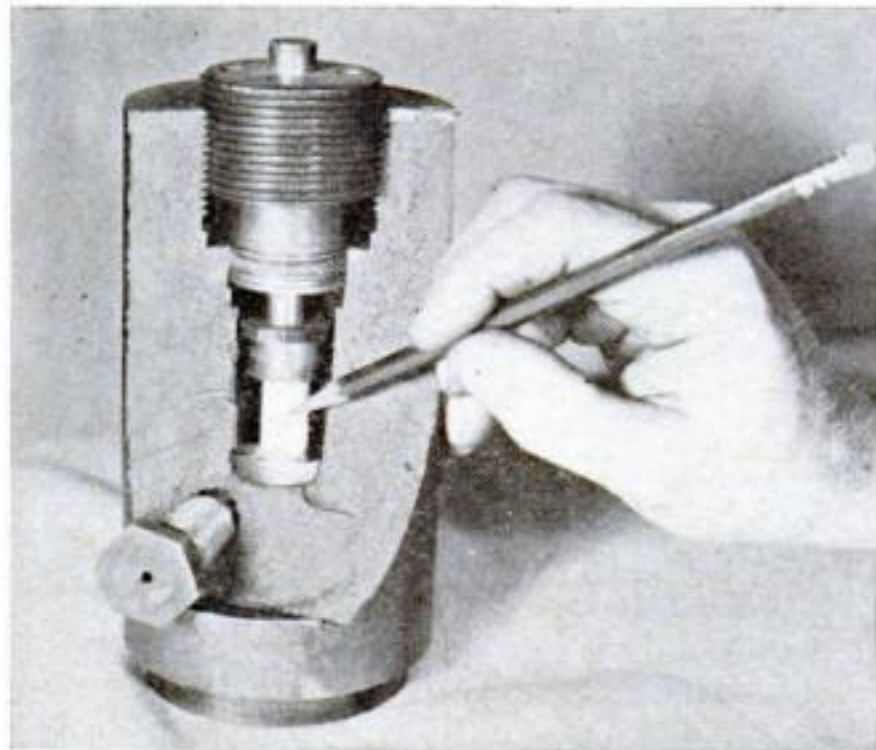
steel, lose their brittleness under pressure and can be bent.

On the other hand, graphite flows, like molasses. Why bother with graphite? Well, for one thing, graphite is native carbon and so is a diamond. In her own high-pressure laboratory, Nature has transformed something soft and black and cheap into something almightily hard and precious. Maybe man can, too.

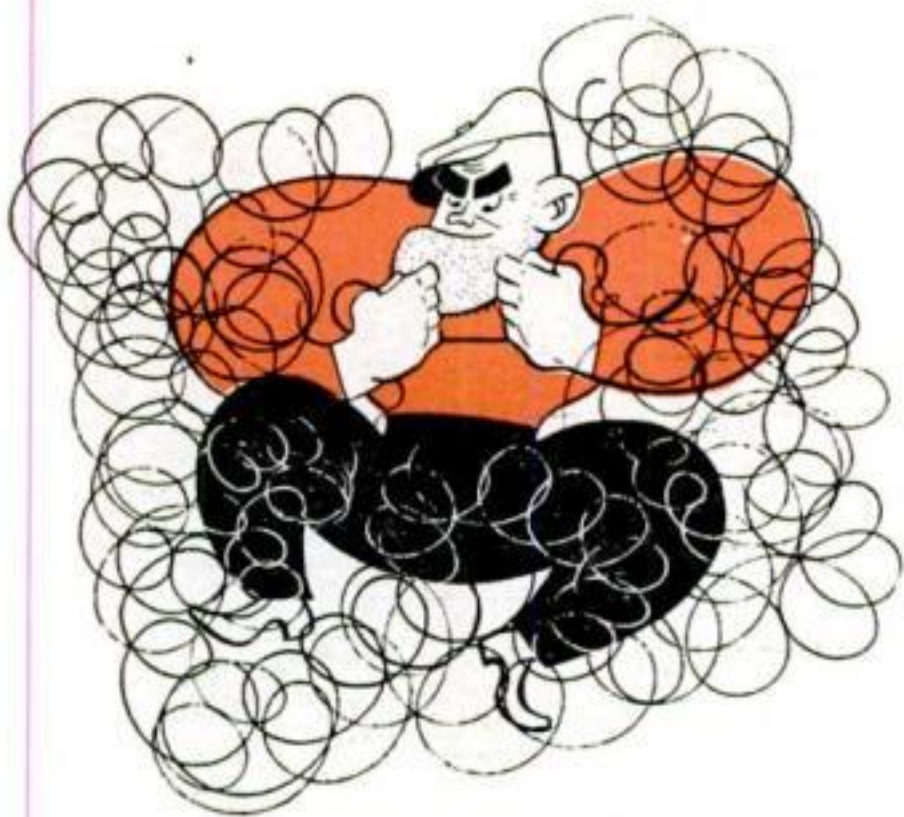
Bridgman at various times has tried to find out. Theoretically the change ought to occur somewhere around 30,000 atmospheres, but one of the problems here, as in other high-pressure experiments, is the smallness of the working space. The higher the pres-



This cylinder, similar to those used in high-pressure apparatus, has been strengthened by internal high pressures. Now Dr. Francis Birch of Harvard measures how much it has stretched.



This heavy steel cylinder has been broken apart by the tremendous internal pressures developed by Bridgman's apparatus. Pencil points to where test material was subjected to squeeze.



High Pressure Pete can pull steel wire out to 300 times its original length by putting it under a pressure of 25,000 atm. The wire becomes stronger than when treated by any other method.

sure, the smaller the apparatus, primarily because only small pieces of steel can be hardened all the way through, and if they aren't hardened all the way through, they burst. Expense and time also figure in: there's a limit to what one man and a few assistants, working on a university budget, can do.

Bridgman's first work at the theoretical graphite-into-diamond pressure was done in a vessel only a quarter-inch in diameter. A few years ago, however, three commercial companies—General Electric, Carborundum, and Norton—financed a study that enabled him to build apparatus for attaining 30,000-atm. pressure in a much larger space—two inches wide and several inches long—and to apply great heat at the same time.

No diamonds. But the physicist did prove beyond all doubt the essential sameness of the two substances. For, though graphite did not turn into a diamond under the particular conditions he was working with, a diamond did turn into graphite. Furthermore, the results hinted that with the right pressure and heat, diamond synthesis was possible.

Bridgman is as curious about what happens to ordinary rock under pressure as he is about what happens to ordinary graphite. And the pressure changes in rocks promise to be of commercial as well as scientific interest. For pressure squeezes out their porosity, and it's the porosity that affects the speed of the elastic waves the seismograph picks up. Geologists can't see what lies deep beneath the surface, but Professor Francis



Ice can be made—when Pete puts it under a 40,000-atm. squeeze—that will turn to water only at the temperature of melting solder. This ice is heavier instead of lighter than water.

Birch and others using Bridgman's methods can duplicate the pressure and heat conditions that exist there. In this way they are piling up facts about the changes in minerals under those conditions—facts that one day may prove invaluable to the prospector using seismologic techniques.

Almost everything put into Bridgman's pressure chambers undergoes polymorphic transition—changes in crystal structure that do not affect the chemical composition. Camphor, for instance, under pressure exists in 11 different forms. With the exception of diamond-into-graphite, however, only two nonreversible processes have been found so far. At 40,000 atmospheres, and 175 degrees Centigrade, carbon bisulfide, an evil-smelling liquid used as a solvent, becomes a black solid and stays that way. And at 12,000 atmospheres and 200 degrees, yellow phosphorus becomes black and, unlike the yellow, conducts electricity.

For the present there is nothing to do with Bridgman's mass of material on these polymorphic changes except, as he puts it, to store them "like a collection in a museum, waiting for the later moment of illumination."

When Bridgman began his work in 1905, the highest pressure anyone had reached was 3,000 atmospheres. It was applied by an hydraulic press, operating through a piston, on material inside a steel cylinder, and the limit was set by leakage of the pressure medium. Bridgman stopped the leakage by devising a method whereby the pressure on the rubber packing in the cylinder head was always



Making diamonds out of ordinary graphite is a job High Pressure Pete may be able to pull off some day. To do it, though, he will have to match nature's great heat and high pressure.

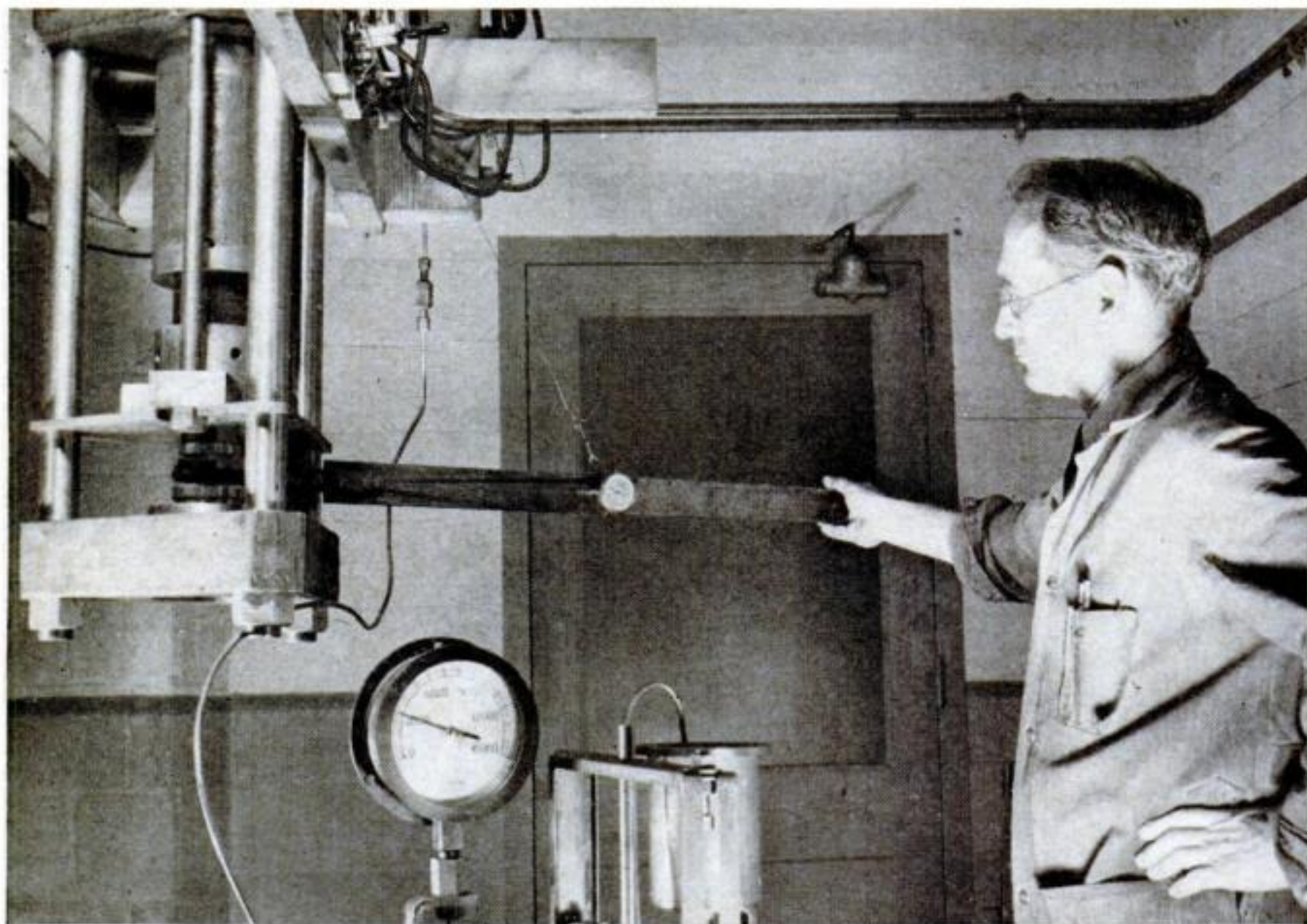
greater than that on the material under study: the higher the pressure, the tighter the vessel became.

Now the limit was set by the strength of the cylinder. At various points above 3,000 atmospheres, steel vessels would rupture

even though they were four or five inches thick and the pressure chamber inside only half an inch wide. Sometimes the break would come with explosive force; once a hunk of steel shot off and sailed through a window 15 feet away. Bridgman says with a straight face that his efforts to learn how far he could safely apply pressure were "not without danger"; actually, he is lucky to have come through alive. Nowadays he has steel plates half an inch thick shielding all dangerous apparatus.

Using the best heat-treated alloy steels, the physicist eventually reached a workaday pressure of 12,000 atmospheres. Above that, his vessels kept bursting: to go higher he needed to give them greater external support. He solved the problem by building a vessel with a conical shape and then, as pressure was built up inside, driving the whole vessel into a conical seat, as a stopper is pressed into the neck of a bottle.

This method worked fine, up to a point. But at 50,000 atmospheres the big push inside was so great that the apparatus showed signs of going to pieces in all directions, like the deacon's one-hoss shay. Again the prob-



This apparatus, combining shearing stress with hydrostatic pressure, is used for exploratory measurements at extremely high pressures. A pressure of 50,000 atmospheres is concentrated

on $\frac{1}{4}$ -in. boss near end of lever in hanging apparatus at left. Dr. Bridgman, at right, is looking at a gauge that reports the amount of shearing force applied by pulling the lever.

lem was to get more support for the pressure vessel. Bridgman met it this time by building a nest of machines—one tiny one inside another.

In the outer apparatus, of steel, a pressure of 30,000 atmospheres is reached by compressing a liquid like pentane. This pressure keeps the apparatus inside from flying apart. The inner machine is a steel-jacketed Carboloy [®] cylinder. Through the Carboloy, an extremely hard material that can be cut only by diamonds, a hole one-sixteenth inch in diameter has been bored. The material to be examined is placed in this hole, and two tiny Carboloy pistons are pushed together upon it. Their thrust, which reaches 100,000 atmospheres, is measured by an electrical device immersed in the fluid.

The same principle of a squeeze within a squeeze makes possible the extreme pressure of 425,000 atmospheres. But in this case, instead of a cylinder and pistons, Bridgman uses two Carboloy blocks, and the material to be examined—a mere flake—is placed between them. Tiny though the sample is, it can be examined afterward by X ray to see if there has been any permanent change.

Still higher pressures are possible, but they will require two stages of support—a machine inside a machine inside a machine—and right now Bridgman feels he has plenty of work cut out for him at lower ranges.

Others Use High Pressures

Other scientists are following his trail. Geophysicists at the Carnegie Institution recently made talc and some other minerals in a tiny high-pressure chamber that duplicated conditions several miles down in the earth. The Bureau of Mines and the Army are using Bridgman apparatus to test explosives. And the Bureau of Standards is installing a 10,000-atmosphere machine for studies expected to standardize the measurement of high pressures.

Bridgman's latest feat is atom-smashing—not by bombardment but by squeezing. Recently he put a sample of the element caesium, a white metal of butterlike consistency, into his high-pressure apparatus. At 50,000 atmospheres, when the limit in tissue changes had been reached and no further shrinkage could be expected, it suddenly collapsed. Something had happened to the caesium atom—one of the electrons had been forced out of position. Practical significance? Bridgman shrugs. What have atoms to do with ordinary people? **END**



Lenses Cut Faster

THE new automatic optical machine shown above shapes eyeglass lenses in half the time needed for hand grinding. A diamond tool set in a swinging head makes both spherical and cylindrical curves in one operation in less than a minute. It is made by American Optical Co.

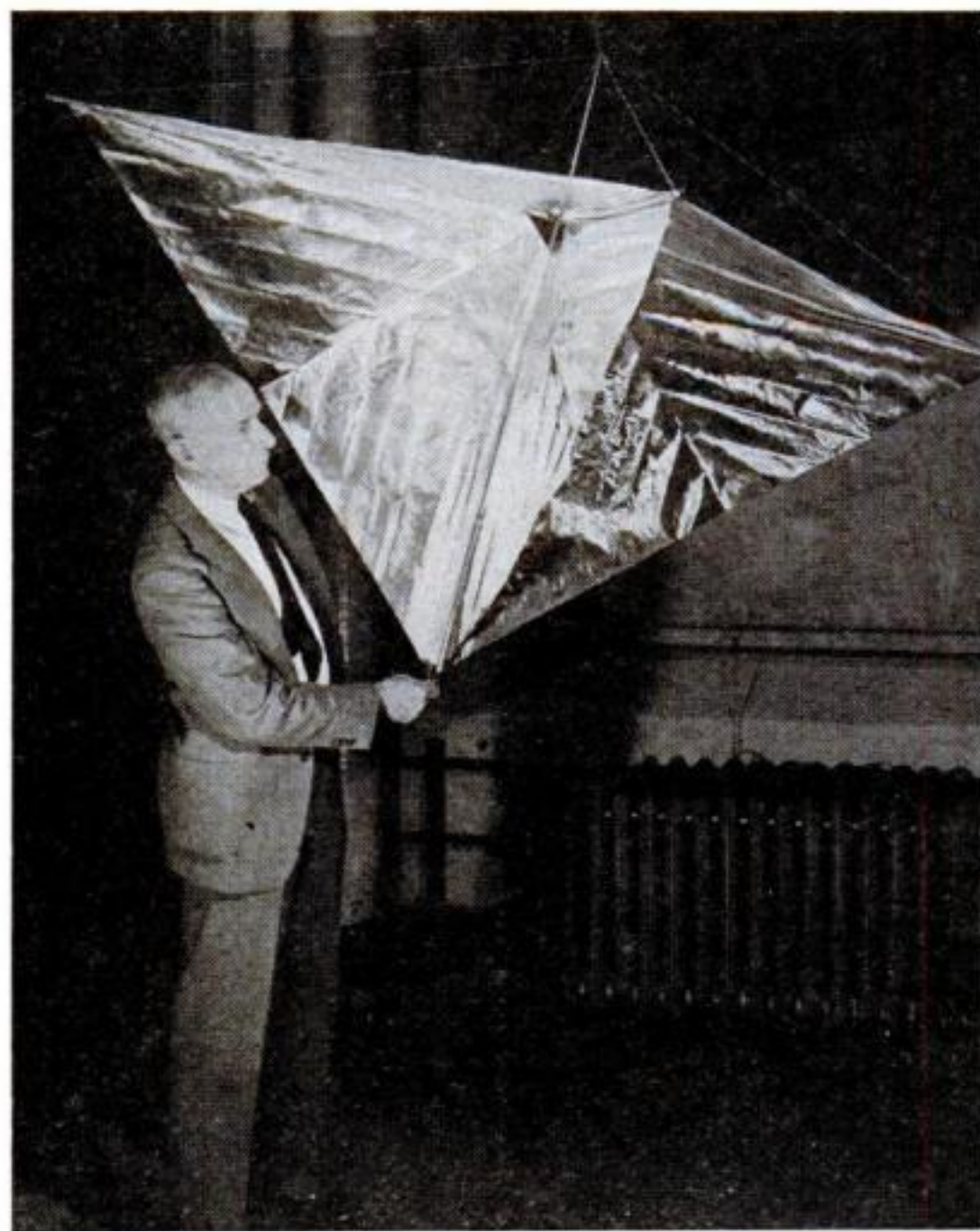


Double-Duty Cooker

FOR quick frying or cooking, the new Hotpoint unit shown above is raised to the top of its receptacle, giving your electric range an additional surface burner. To simmer stews or soups, the unit is lowered to the bottom, so that you have a deep-well cooker as well.



Sorting cats was the object of this Kearsley invention, assembled from laboratory odds and ends, at one of his cellar windows. It would admit Mickey, his black pussy, but photo cell would bar unwanted visitors by slamming a weighted door in face of cats of wrong color. Trials were pending when a truck—which did not discriminate among cats by their color—ended Mickey's career and the project.

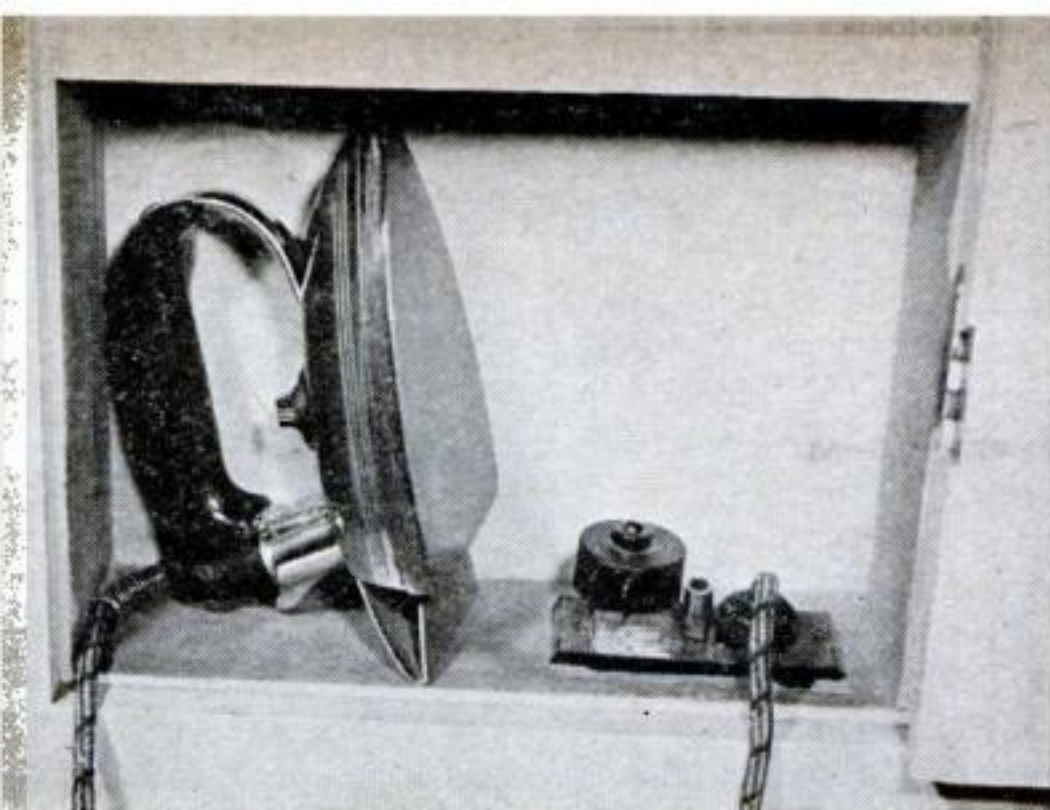


Aluminum-foil "Angel" for war use, which Kearsley exhibits in illustration above, was one of his many professional inventions. It was designed to deceive enemy radar operators by giving a radar "echo" simulating a large bomber as it floated to earth, like a parachute, after being tossed from a plane. For an aerial feint, a modest force of aircraft dropping "Angels" could masquerade as a mighty bombing fleet.

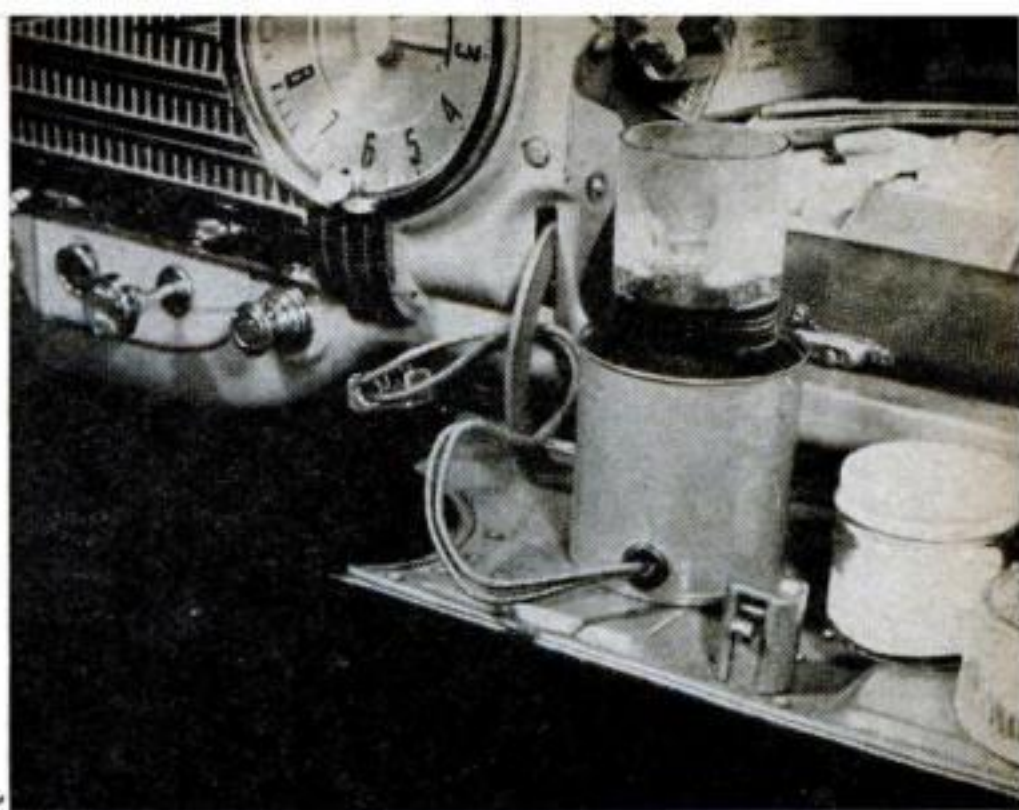
Electric blanket, one of Kearsley's best-known inventions, keeps him warm on cool nights. Having set automatic temperature control, on bedside table, he relaxes in solid comfort to finish a PS article before he calls it a day.

Retired Inventor Makes Home a Gadgeteer's Dream

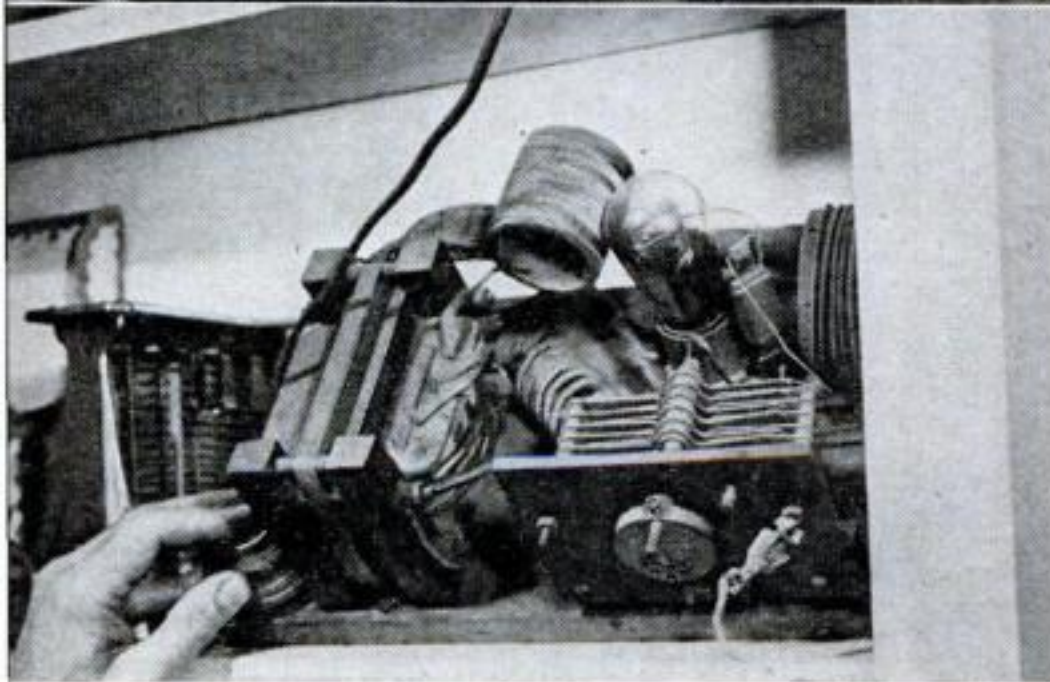
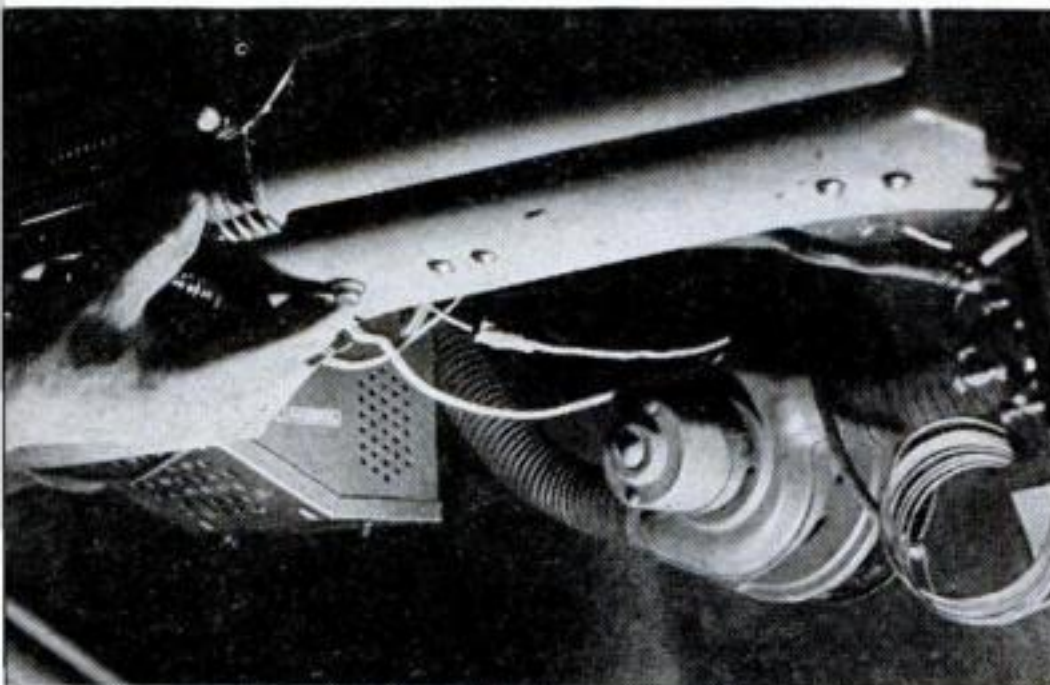
INVENTING is a lifelong habit with William K. Kearsley, retired General Electric Research Laboratory engineer. The man responsible, during his 44 years with GE, for the electric blanket and many another well-known product, now applies his ingenuity to devising conveniences for Mrs. Kearsley and himself in their Schenectady, N. Y., home. Demise of a cat shelved one of his most original ideas, but the others shown on these pages serve him well.



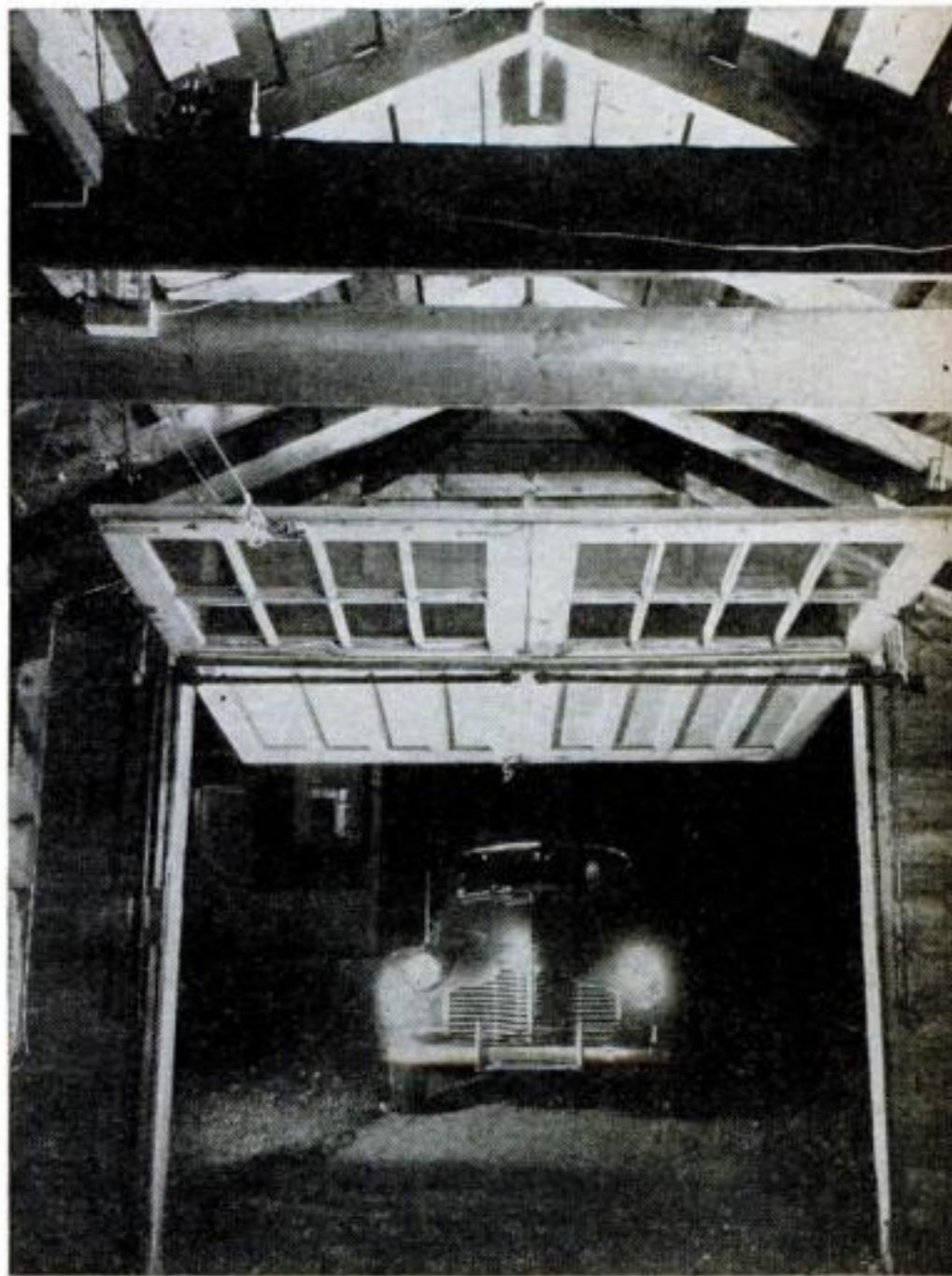
When Mrs. Kearsley drops her ironing to answer the phone, and it's an old friend, she needn't interrupt conversation to turn off the iron. Automatic timer built by Kearsley does it for her after preset number of minutes. Slow-flowing, GE bouncing putty oozes through aperture in spring mechanism, letting cover turn and trip key switch. A similar timer douses cellar light after user comes upstairs.



While she is on a drive, Mrs. Kearsley indulges her fondness for afternoon tea with aid of this set her husband made for her from a paint can, resistance wire, and a handy piece of laboratory glassware. Taken from glove compartment, heater plugs into socket on dashboard, as shown, to use current from car's battery. It boils the water in 10 minutes. Separate containers provide all the fixings.



Radio control for his garage doors enables Kearsley to open them from driver's seat of his car, or before stepping out of the house in stormy weather. He can also close them after he comes indoors. Push button beneath dashboard, in upper view above, operates car transmitter that does the trick. Transmitter in lower view, also worked by push button as shown, is on kitchen shelf near back door.

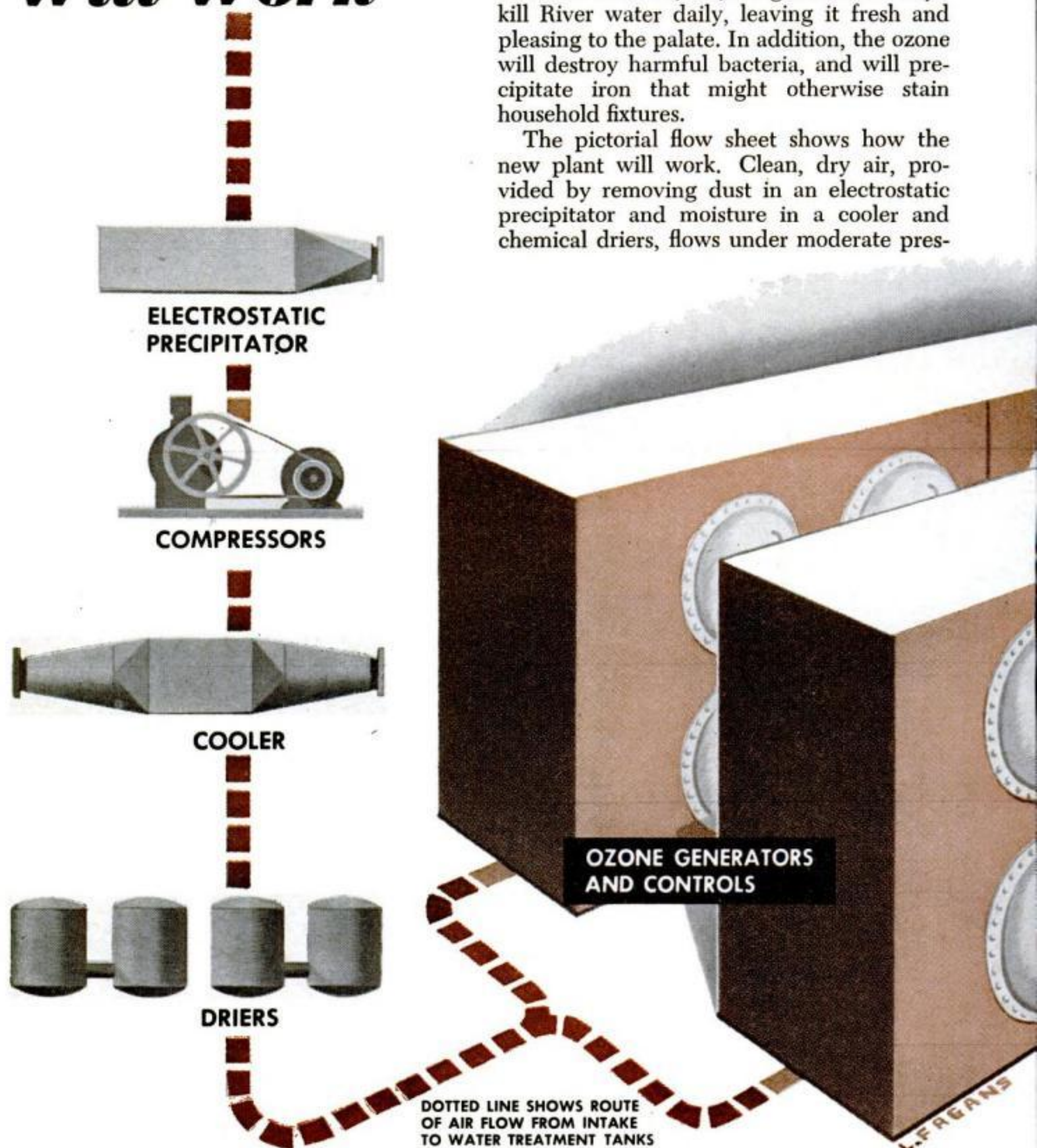


Garage doors obediently swing open as Kearsley, turning into his driveway, touches push button in car. Receiver on wall picks up signal and actuates homemade system of motors, cables, and counterweights that tilt and raise door frame. Next time receiver picks up a signal, which will come from set in house after Kearsley has gone indoors, it will operate system in reverse to lower the doors again.

How Biggest Ozone Plant In the World Will Work

PHILADELPHIANS will enjoy purer and tastier drinking water when the world's largest ozone-generating plant, designed by the Welsbach Corporation of Philadelphia, goes into action this summer. Fifty ozone generators resembling fire-tube boilers, each one containing 85 four-foot electric glow discharge tubes operating at 15,000 volts, will manufacture a total of 1,250 pounds of ozone a day. The powerful oxidizing action of this gas will banish any trace of undesirable taste and odor from 36,000,000 gallons of Schuylkill River water daily, leaving it fresh and pleasing to the palate. In addition, the ozone will destroy harmful bacteria, and will precipitate iron that might otherwise stain household fixtures.

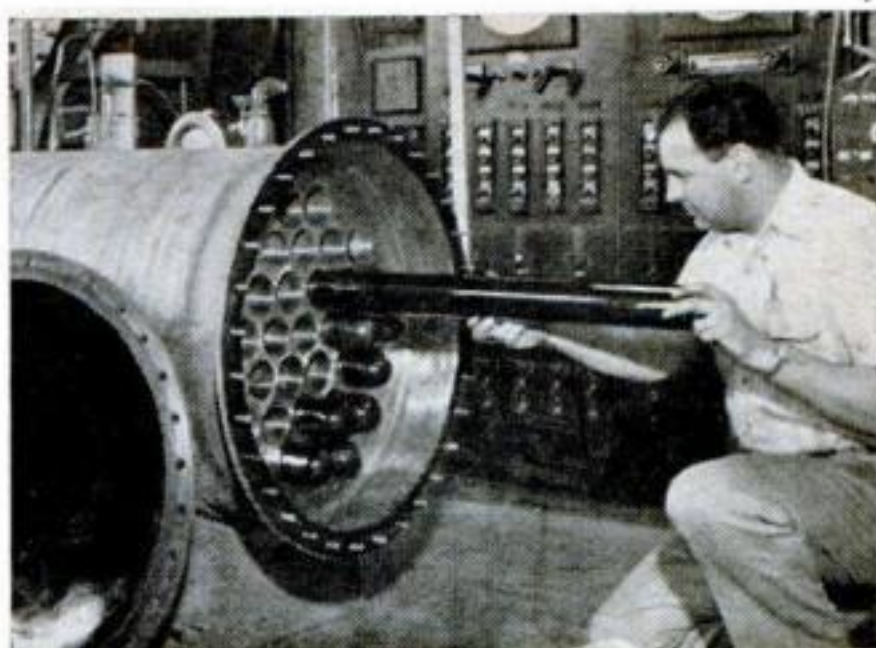
The pictorial flow sheet shows how the new plant will work. Clean, dry air, provided by removing dust in an electrostatic precipitator and moisture in a cooler and chemical driers, flows under moderate pres-



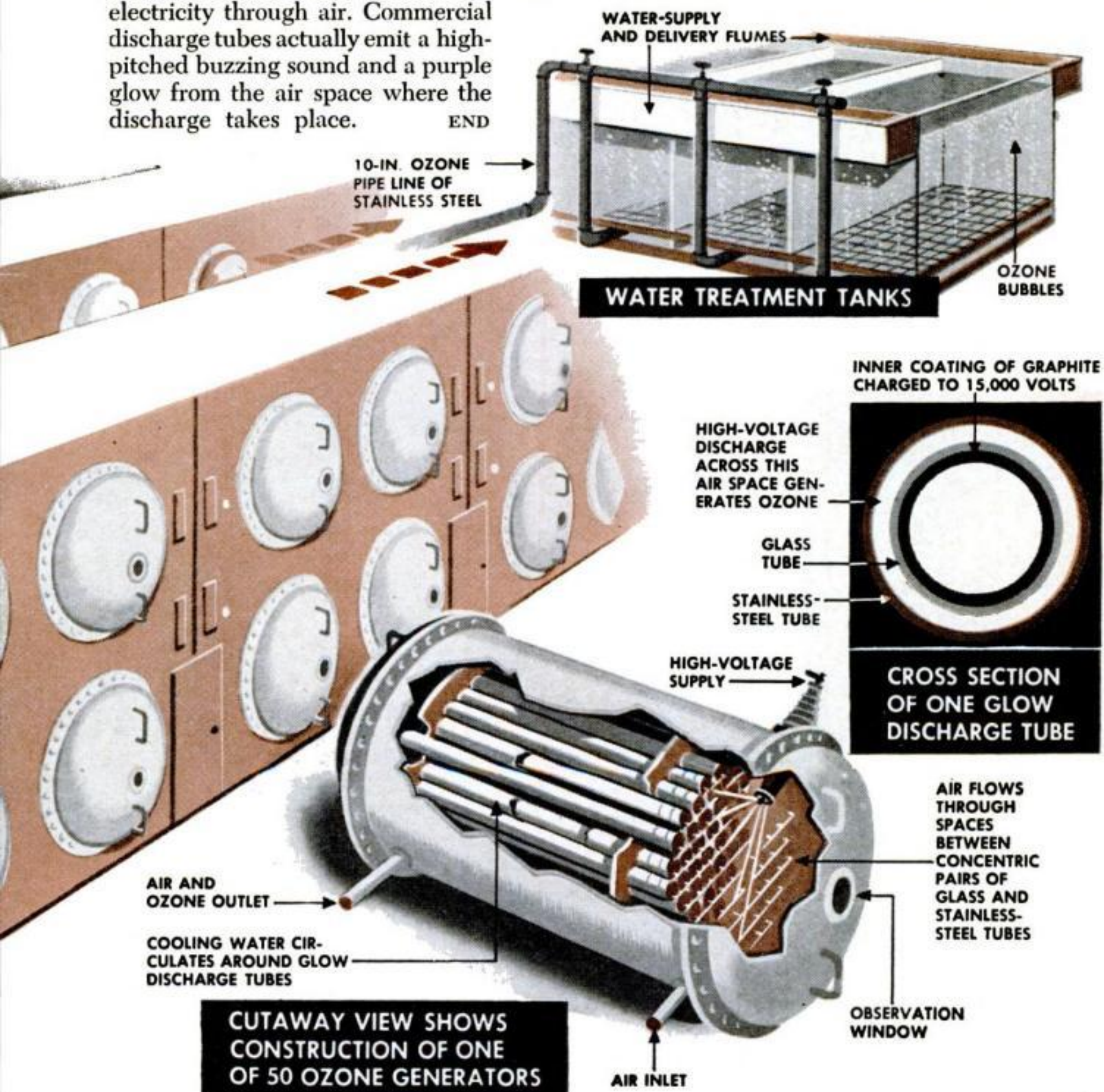
sure through the high-voltage chambers that convert part of its oxygen to ozone. The ozone-bearing air then bubbles upward through water in treatment tanks.

More expensive than chlorine for disinfection alone, ozone pays its way when chemical waste from near-by industrial plants makes the water taste bad. Unlike chlorine, ozone can leave no taste of its own, since it rapidly turns back into oxygen. It has been used widely abroad. The largest American ozone plant to date treats 3,000,000 gallons of water daily at Whiting, Ind.

Ozone, whose interesting properties are described on pages 234-236, is the faintly blue, pungent-smelling gas produced by a high-voltage "silent," or glow, discharge of electricity through air. Commercial discharge tubes actually emit a high-pitched buzzing sound and a purple glow from the air space where the discharge takes place. **END**



Fifty ozone generators in new plant will be larger counterparts of this one. Photo shows a high-voltage, graphite-lined glass tube being placed in its tubular, stainless-steel cell.

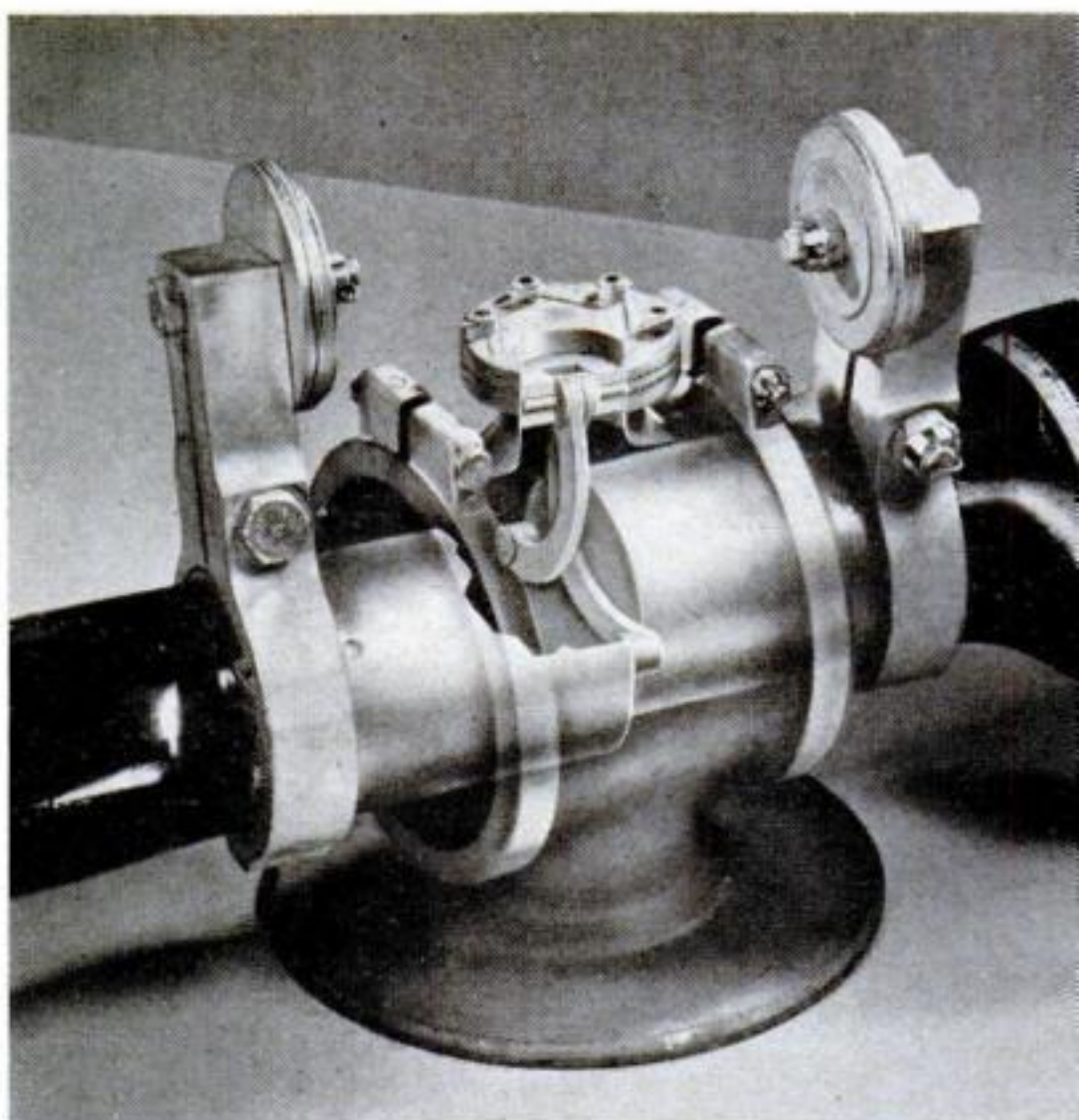


Propeller Adjusts Itself

THE dream of every lightplane pilot, a fully automatic-pitch propeller, has come true. Climbing, the new Aeromatic[®] goes into flat pitch to obtain maximum pull. Cruising or gliding, it increases its pitch to boost the speed. There is no cockpit control, the prop thinks for itself.

A simple hub assembly, in which centrifugal force does most of the work, contains two counterweights and a synchronized piston. The propeller blades are set at a slight angle to the hub, so that they lag behind it in the plane of rotation.

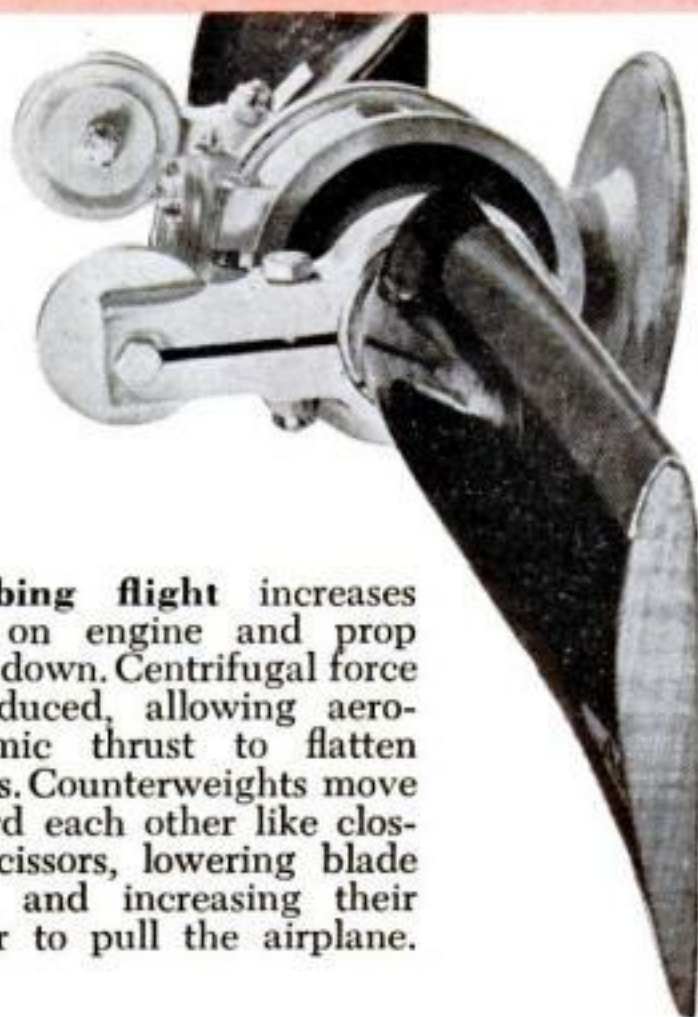
During installation, adjustments for the desired limits of pitch range, for balance, and for the combination of aircraft and engine can all be made without opening the sealed hub. The manufacturers, the Bartlett Hayward Division of the Koppers Co., of Baltimore, claim that the prop not only provides maximum plane performance for a given fuel consumption but saves engine wear and tear by preventing overspeeding.



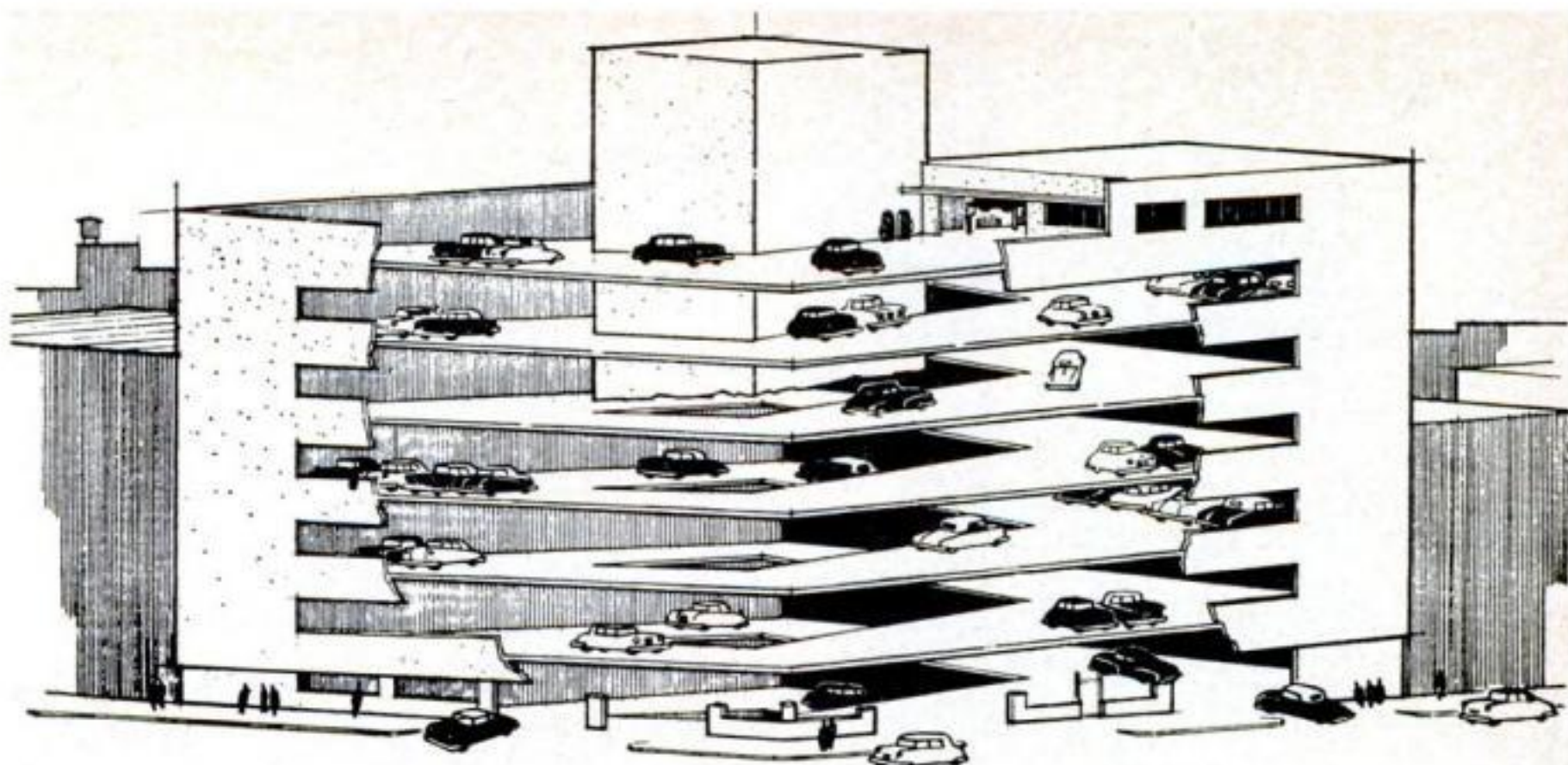
Cutaway of Aeromatic[®] automatic-pitch prop, above, shows how blades are connected inside hub. Two link arms and a piston take the place of gears. Disks on two upright arms are counterweights that automatically control the pitch as shown in drawings and photographs below.



In level flight, load on engine lessens, prop speeds up. Increased centrifugal force now tries to push counterweights away from center, but, due to the way arms are set, instead pulls them apart like opening scissor blades. This increases prop pitch for added bite and more speed.



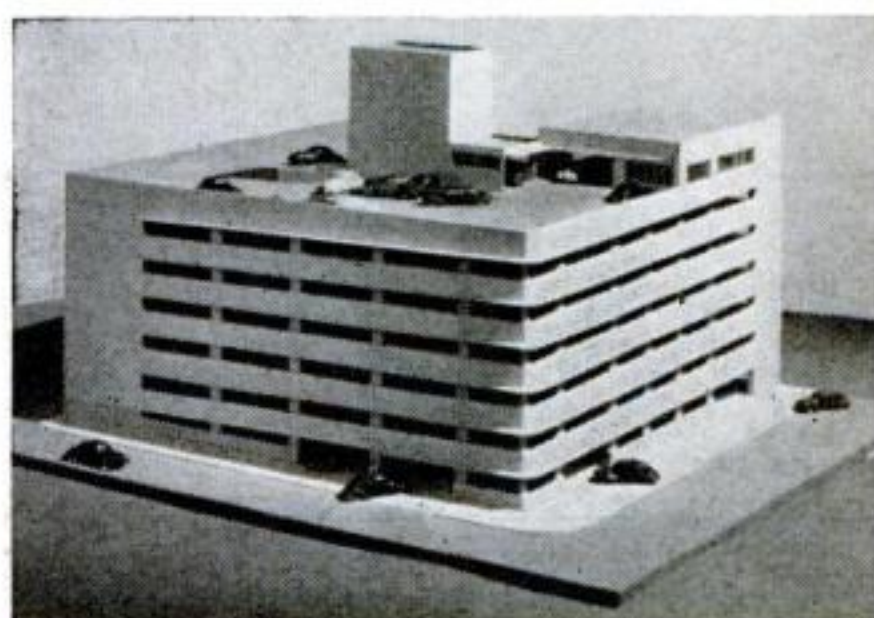
Climbing flight increases load on engine and prop slows down. Centrifugal force is reduced, allowing aerodynamic thrust to flatten blades. Counterweights move toward each other like closing scissors, lowering blade pitch and increasing their power to pull the airplane.



Spiral Floor Eases Parking Headaches

A SINGLE continuous floor twisting like a corkscrew from the first to the sixth story makes this modernistic garage truly self-parking. The floor, wide enough for two-way traffic, spirals upward on a four percent grade around a central core containing a passenger elevator and stairway. Parking stalls are in a 20-foot-wide parking strip running along the walls from basement to roof. To park, the driver simply pulls into a vacant space. On leaving, he backs his automobile into the down-traffic lane and drives to the exit at the street level.

Designed to go with a large Los Angeles



office building, the garage occupies a lot 145 feet wide and 152 feet deep. It will accommodate 446 cars. Service facilities are provided for on the top floor.



Tugs Hitch Ocean Ride

WHEN Argentine interests bought six, 74-foot, steel Army-surplus tugs, the problem was how to transport them to Buenos Aires. Running them the 10,000 miles from Seattle under their own power would be too costly and too hazardous. They couldn't be shipped for lack of a crane at the destination large enough to unload them.

The Atlas Steamship Chartering Corp. came up with an ingenious solution. The small tugs were float-loaded on a 278-foot steel barge, and towed by a large ocean-going tug. The photograph at left shows the barge being raised in the dry dock in which it had been submerged while the six tugs were floated on. At the destination, arrangements were made for the process to be reversed, the barge again being submerged in a dry dock while the tugs were floated off.



The *Albatross III*, seagoing laboratory, prepares to solve the mystery of the missing fish.

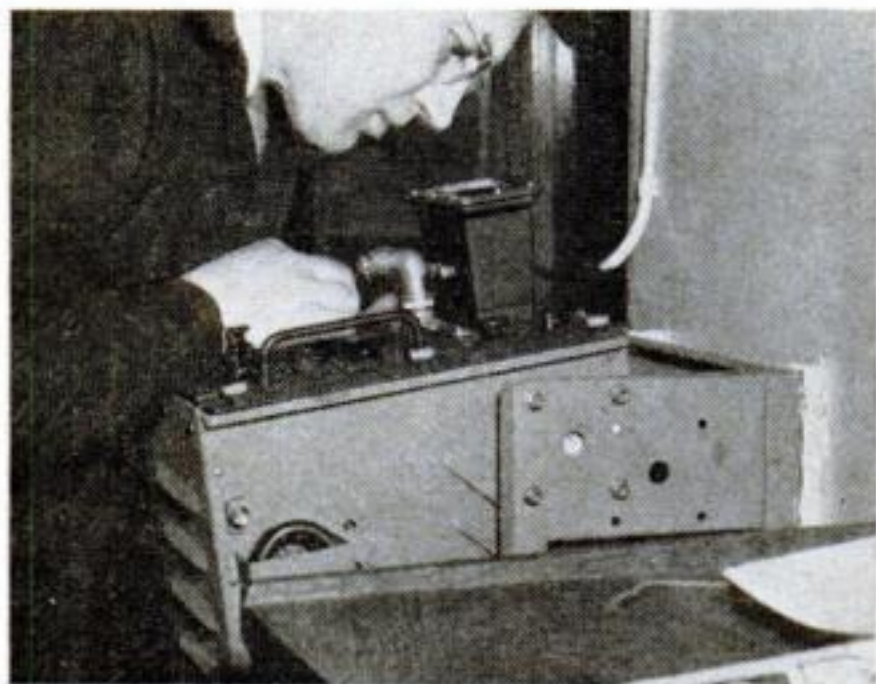
Seagoing Lab Tracks Fish

THIS month a shipload of scientists with the latest oceanographic gear will sail on one of the most important fishing trips on record. They won't bring back many fish, but their findings may tell why there has been a drastic decline in commercial catches from the 20,000-square-mile Georges Bank and other New England fishing areas.

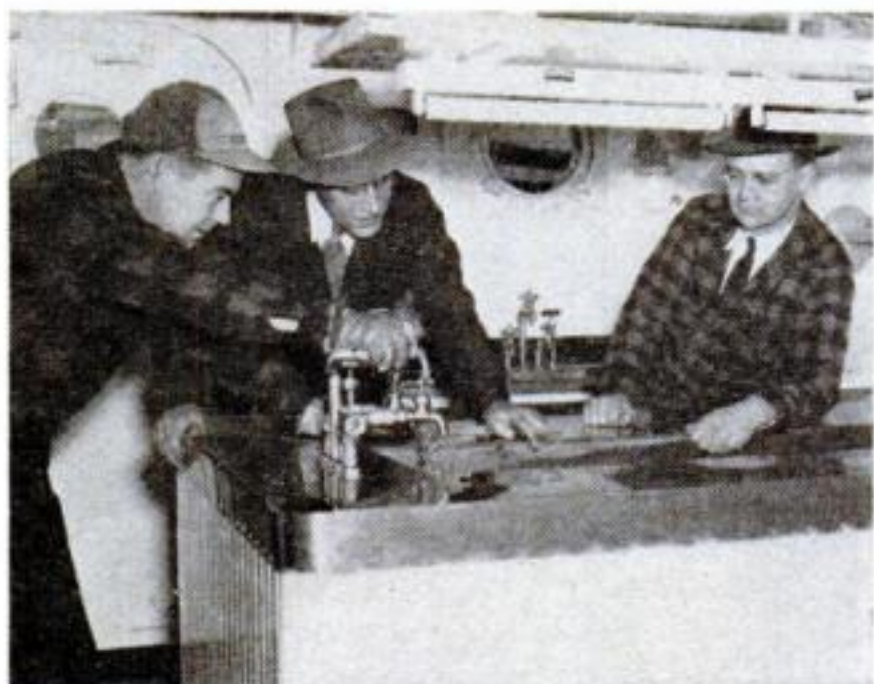
The scientists, from the U. S. Fish and Wildlife Service, will study sea life, make a fish census, and test less wasteful fishing methods. Instruments on their 180-foot ship will record currents and ocean topography.



Super-sensitive sound-beam depth finder, above, records inch-accurate soundings, can detect fish schools close to the bottom. A submarine camera permits direct study of sea life.



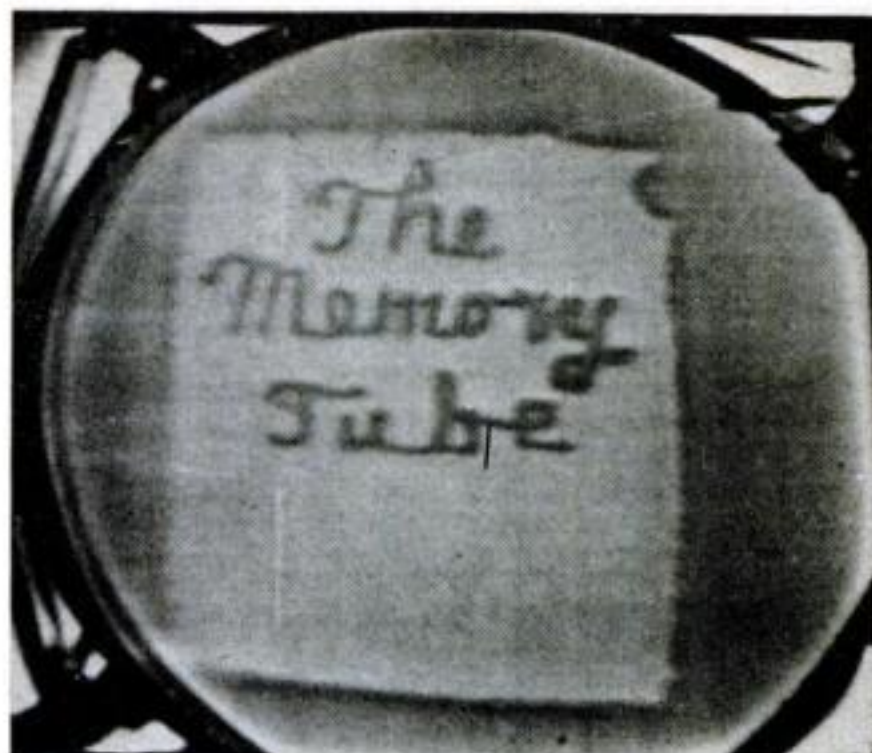
War-developed Loran, above, will be used to chart important spots on Georges Bank, where strong currents balk ordinary surveys. A bathy-thermograph will record water temperatures.



In "wet" laboratory's large, open, water tank scientists will observe fish specimens at close quarters. In "dry" lab adjoining it, they will make chemical analyses of sea-water samples.



The Navy's new electronic memory tube looks a bit like an ordinary cathode-ray tube, but is far more complex. It remembers electric signals by spraying a charge pattern on an insulator.



The "remembered" signal can be displayed on a cathode-ray tube (above). In this case, the signal originates in an optical pickup device, such as facsimile or television equipment.

This Tube Remembers Whatever It's Told

FULL-COLOR, three-dimensional radar and sonar are promised by a new vacuum tube that remembers signals as long as you want it to. It can also be used to communicate by very quick electrical flashes, as the "memory" part of an electronic computing machine, and to catch and record quick flashes of all kinds (such as radio-control signals employed by an enemy in wartime).

The memory tube, developed at the Naval Research Laboratory under direction of Andrew V. Haeff, is built something like an ordinary cathode-ray tube. It paints an electronic "picture" of the signal it is to remember, and reads it back whenever desired.

In the new tube there are three electron beams. The writing beam sprays a pattern of electrical charge that corresponds to the signal. It is controlled by deflector plates to which the signal is fed. The holding beam sprays electrons evenly all over the target to replace the charges picked up by the reading beam. The reading beam moves over the target in the zigzag pattern used in television. Whenever it runs across a charge left by the writing beam, that charge flows from the target to a near-by metal screen.

The current—or "remembered" signal—from the pickup screen can be fed to other circuits or devices, such as an ordinary cathode-ray tube. In the case of the cathode-ray tube, its beam is synchronized with the

reading beam of the memory tube so that it makes the fluorescent screen of the cathode tube glow every time the reading beam "sees" a charge on the memory-tube target. Thus the *charge* pattern on the memory-tube target appears as a *light* pattern.

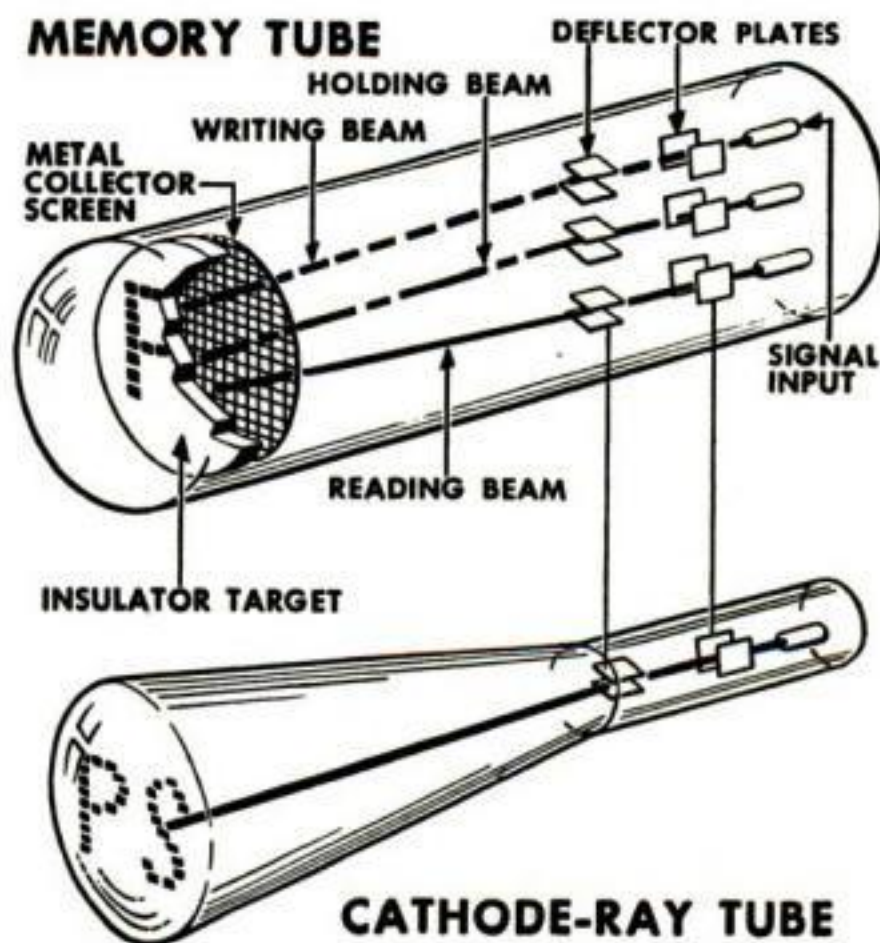


Diagram shows construction of tube and hookup for visual display of signal. The pattern of charge on the insulator target cannot be seen and need not be made visible, since it might be fed to any one of many different types of apparatus—a computing machine, for example.

Next best to getting a new car is to inject new life in the old one. The right kind of servicing does just that.

How an



Instrument tests help spot trouble points quickly.

Expert Does a Tune-up

By R. P. Stevenson

PS photos by Hubert Luckett

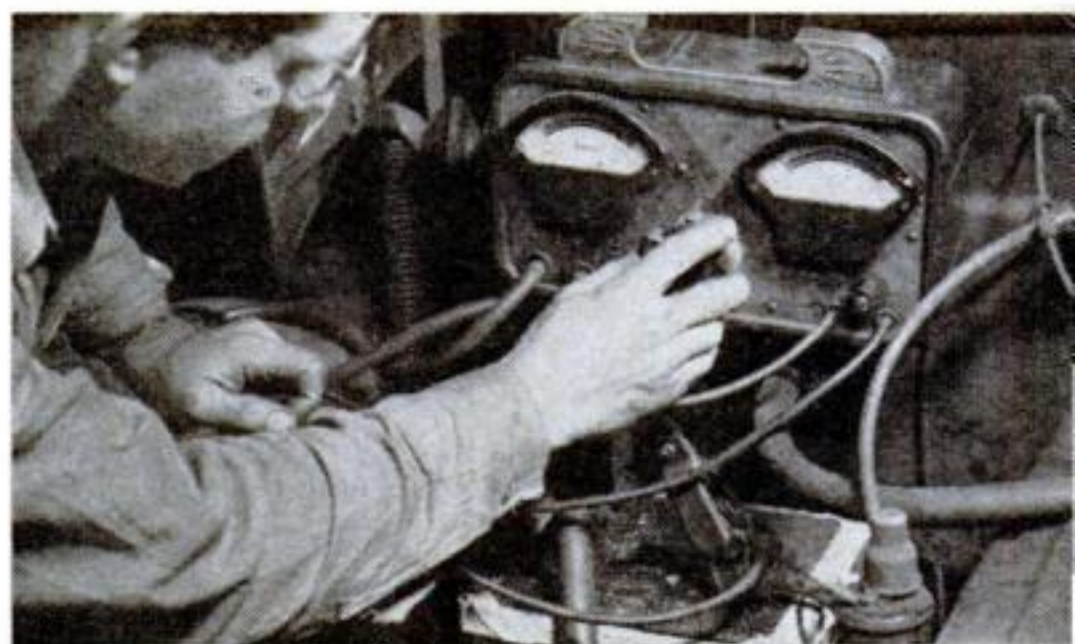
WHAT is an engine tune-up, anyhow? Like the blue-plate special, a lot depends on where you buy it. Different manufacturers specify different procedures, and further variations are introduced from shop to shop and mechanic to mechanic. Sometimes the job is done with little more than a few hand tools and a well-pitched ear; at others it's turned out with enough diagnostic instruments to stock a flight engineer's panel.

However it's done, the underlying idea is to restore some of the efficiency that the engine has lost through use and wear. These inevitably bring a gradual decline in engine performance; vibration jars precise adjustments out of kilter; contacts and electrodes pit and burn away; filters choke up with dirt or sludge; and friction and heat do the rest.

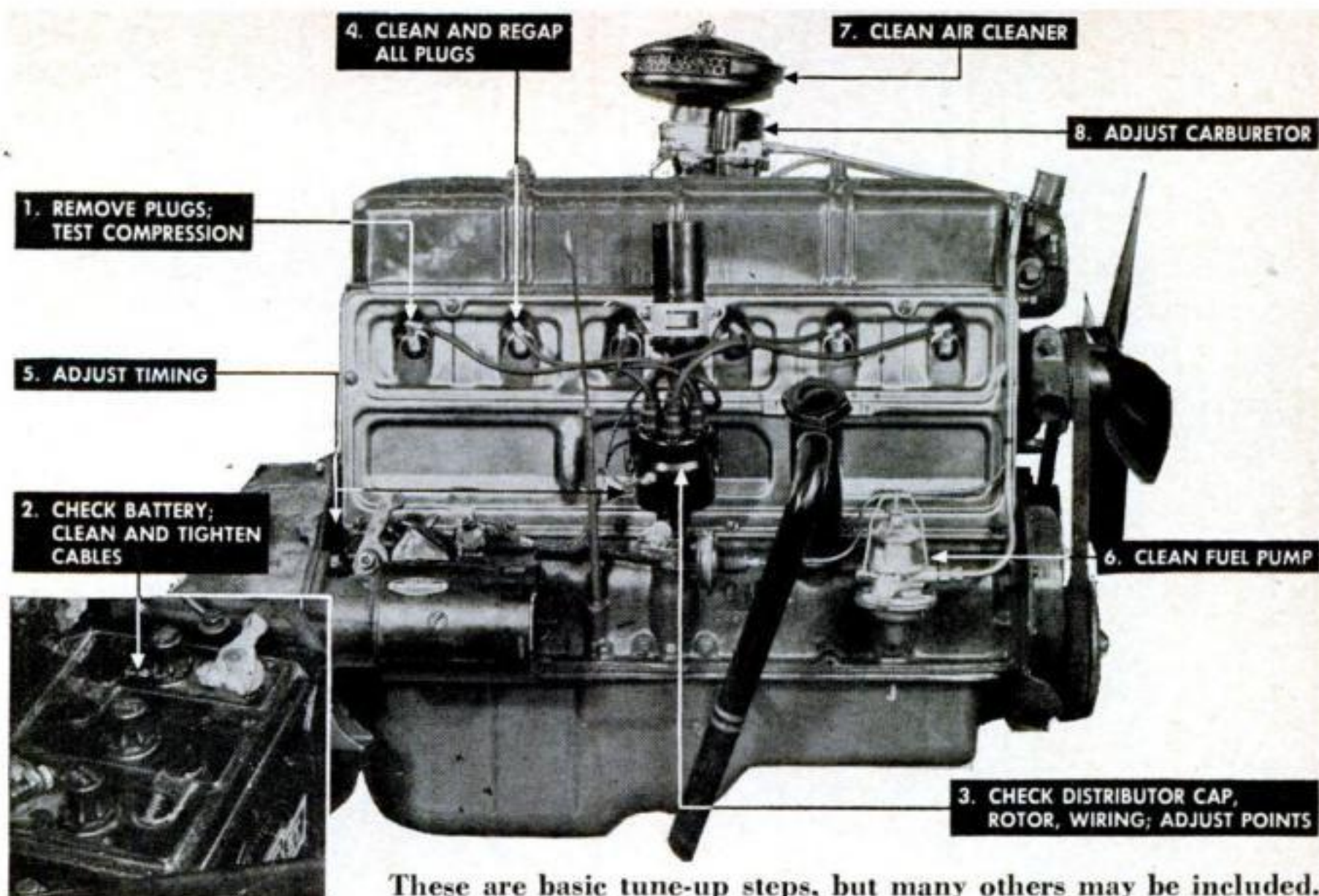
That's why your engine needs a going-over at regular intervals. The job should give you quicker starting, more power and pickup, better gas mileage, and smoother



1. A compression test comes first. An engine cannot be tuned satisfactorily if compression is uneven. In such cases, a valve or a ring job may be required before the tune-up.



2. Good ignition depends on a battery in good shape. Here each cell is being checked under load. Corrosion is removed from terminals and cables examined.



These are basic tune-up steps, but many others may be included.

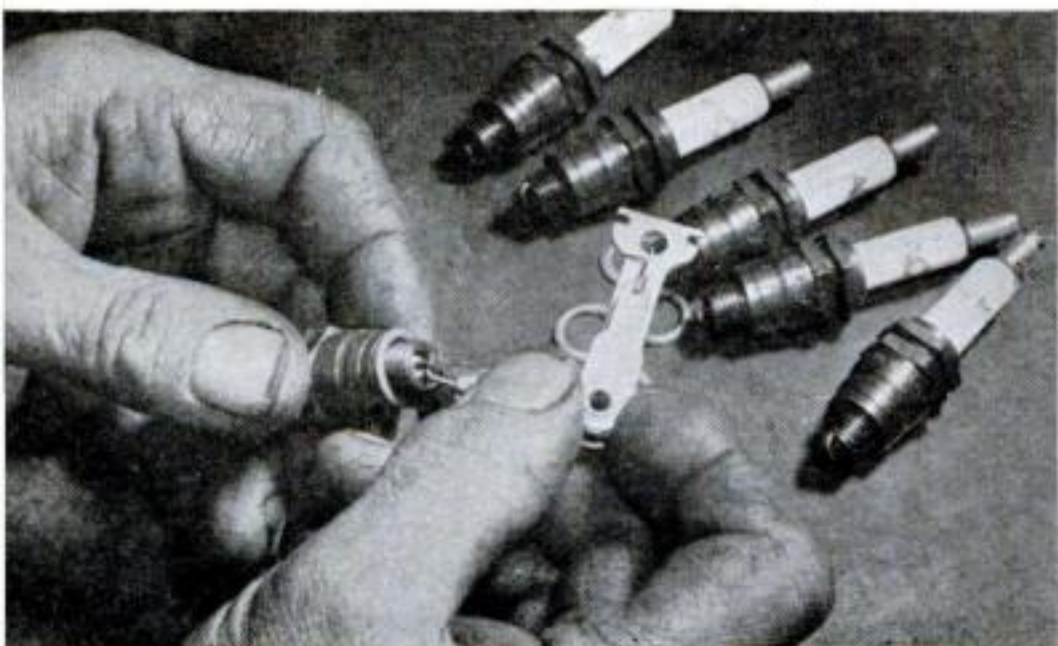
idling. (In evaluating a tune-up your car has had, don't forget that the better shape it was in beforehand, the less improvement you'll notice.) A tune-up may also spot minor trouble before it becomes major, and for that reason alone is a good idea before any long trip.

The accompanying photos show a tune-up done by a competent mechanic with modern equipment. This was an actual job done on a 1946 Chevrolet by John Riccardi, tune-up specialist for the East Side Chevrolet Corporation in New York City, who in his own

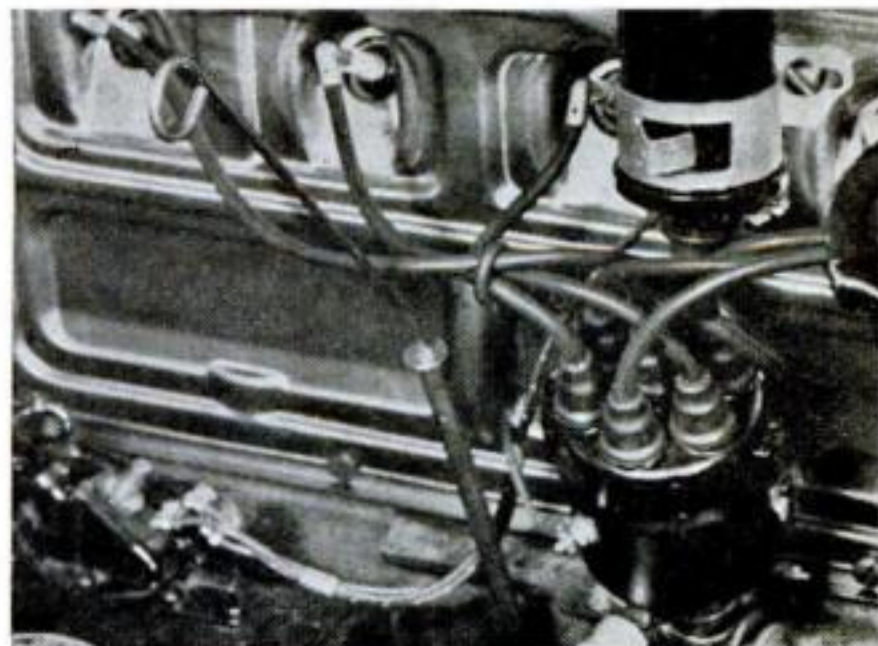
words "began as a kid" and has "been at it for 20 years."

Most automobile manufacturers recommend an engine tune-up each 5,000 miles or twice a year, in the spring and fall, but hard usage under difficult conditions may make it advisable even more frequently. Spring and fall tune-ups coincide with conditioning the car—oil changing, addition or removal of antifreeze, and so on—for the season that's to follow.

Tune-up may be considered to deal mainly with three engine functions—com-



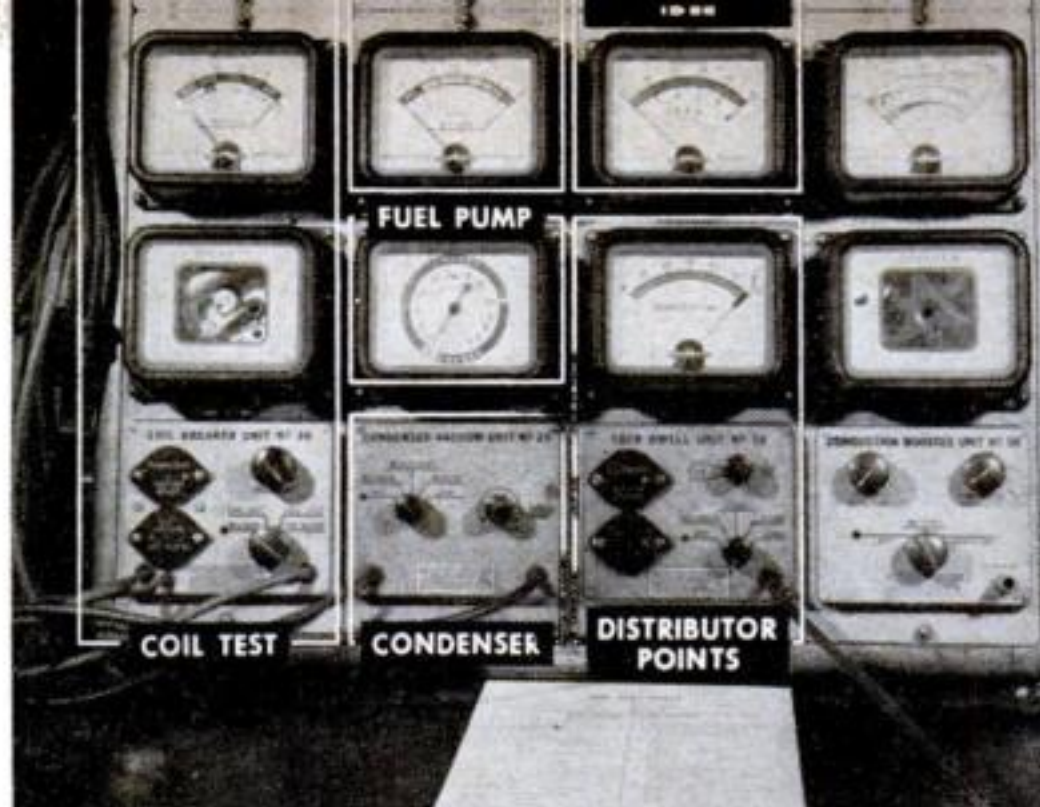
3. Spark-plug gap is set with a wire gauge, even when new plugs are installed as here. If old ones are retained, they're cleaned and inspected for cracks as well as regapped.



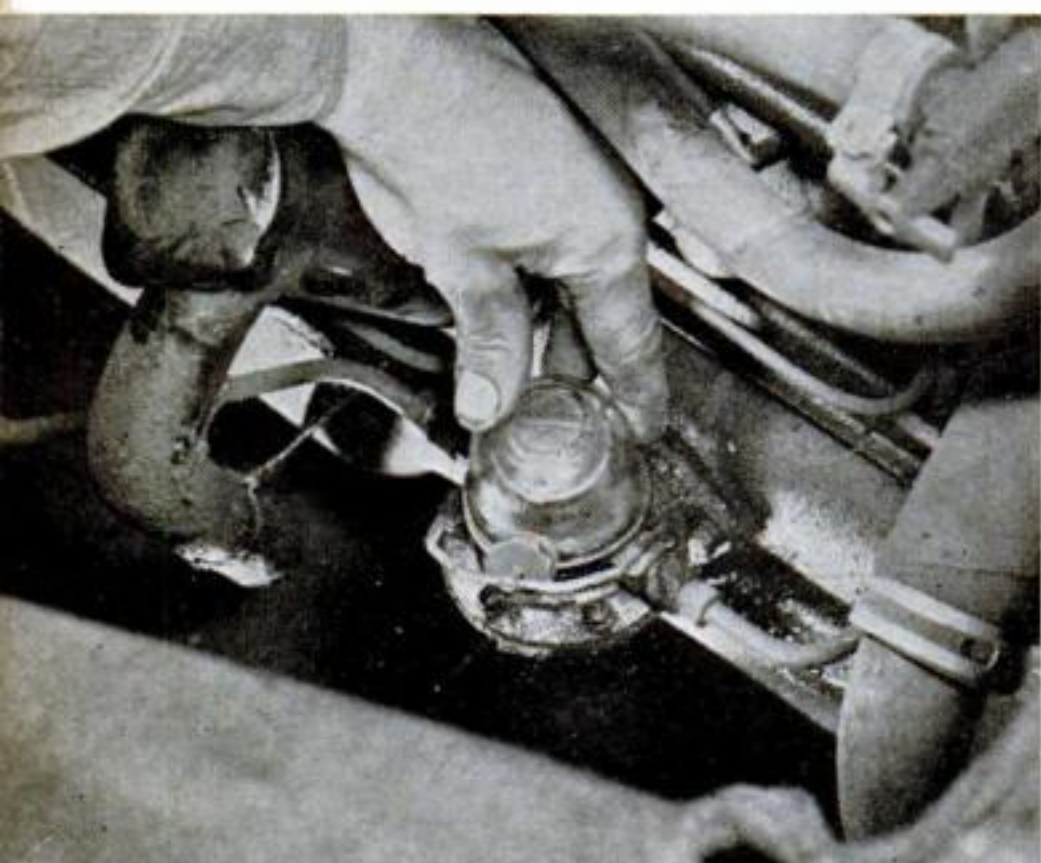
4. Distributor wires were all inspected for worn insulation. After removal, both the cap and rotor were checked for cracks, chips, and burning, and the cap wiped out with a cloth.



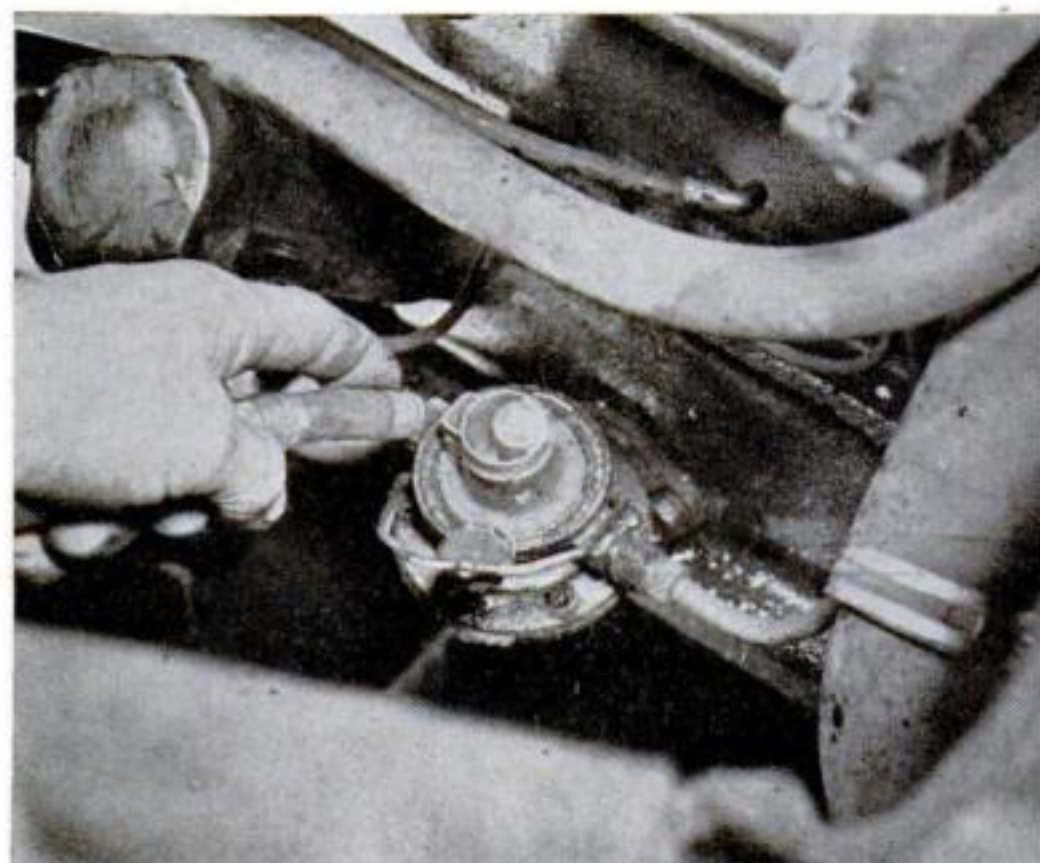
5. Contact points are removed from the distributor and cleaned with a fine-cut file. If the points are badly oxidized or pitted, new points and a new condenser are installed.



6. Degrees of dwell, registered on the motor tester, show whether point setting is correct. The machine also tests coil, condenser, fuel pump, and gives engine a final vacuum check.



9. The fuel-pump bowl is about to be removed here. The bowl was wiped clean and examined for cracks and chips, and the strainer freed of dirt with a blast or two from an air hose.



10. Water and dirt also were blown from the pump with a hose. A new gasket went into the pump when it was reassembled. The gas filter on the line at the carburetor was also cleaned.

pression, ignition, and carburetion. Each engine part affecting any of these is checked and then adjusted if necessary.

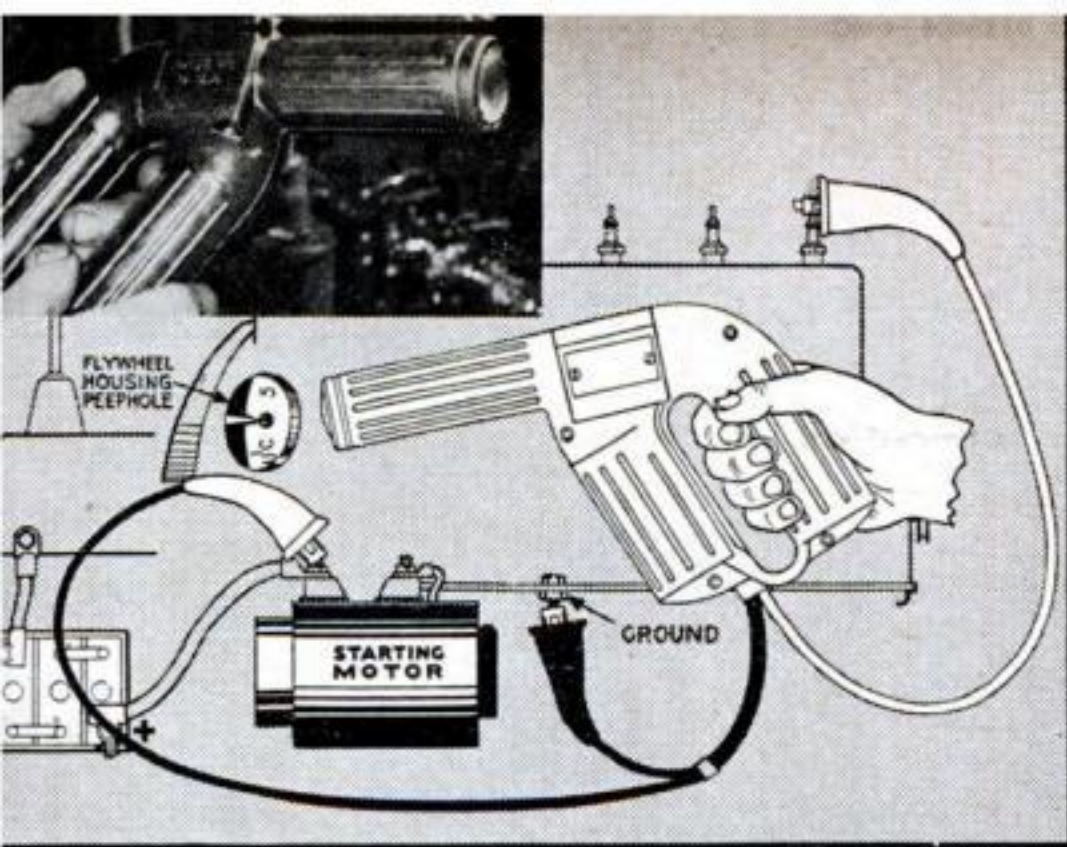
You may also have heard tune-ups classified as major and minor. As the word suggests, a major tune-up includes more steps than the minor. But there is no standardization. What one manufacturer or shop considers a minor tune-up may include steps that another may perform only in the event of a major job.

The tune-up illustrated here was classified as minor. However, the addition of only two other steps—overhaul of the carburetor and blowing out the fuel lines—would have raised it into the major class. In the photos,

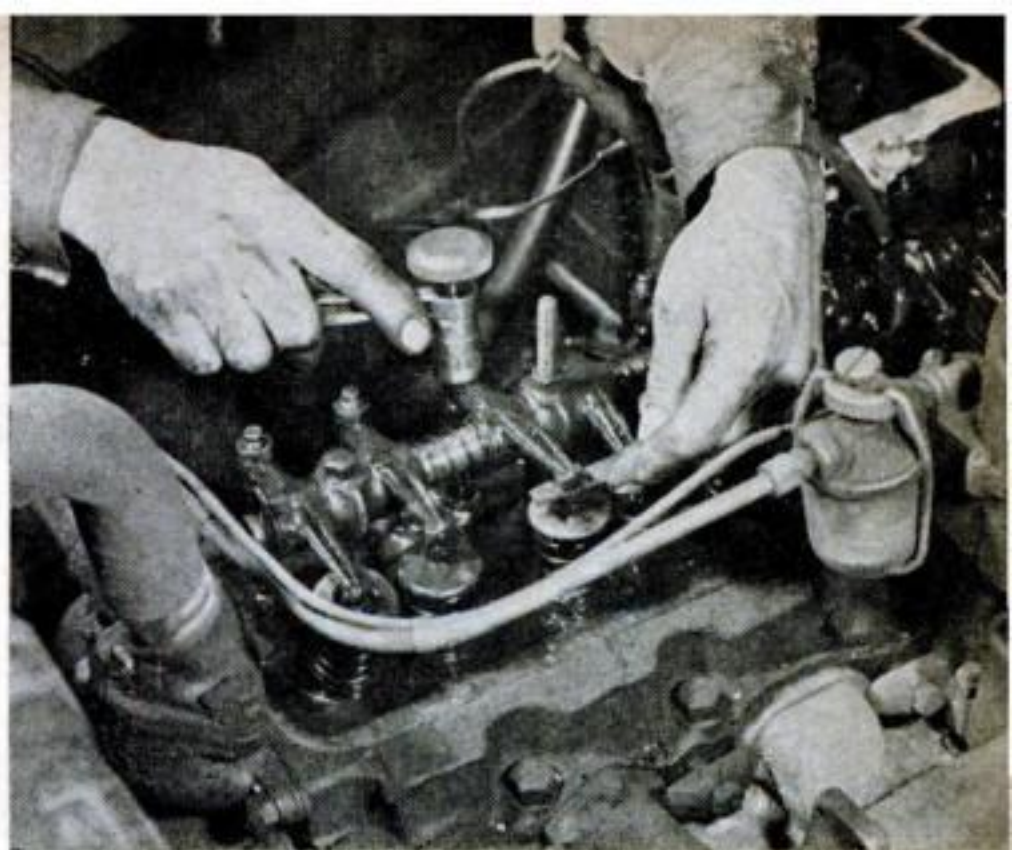
you will notice that the tappets were adjusted to the recommended clearances. This is a customary part of tune-up procedure for an overhead-valve engine. Although not illustrated, fan-belt tension also was adjusted, for slippage will affect generator output.

A more pronounced difference between a major and a minor tune-up is found in the factory recommendations issued for Buick. Here a minor job includes only four points—cleaning and adjusting the spark plugs, adjusting the distributor points, resetting the timing, and adjusting the carburetor.

On the other hand, Buick recommends that a major tune-up should include adjusting the distributor points, timing, carburetor,



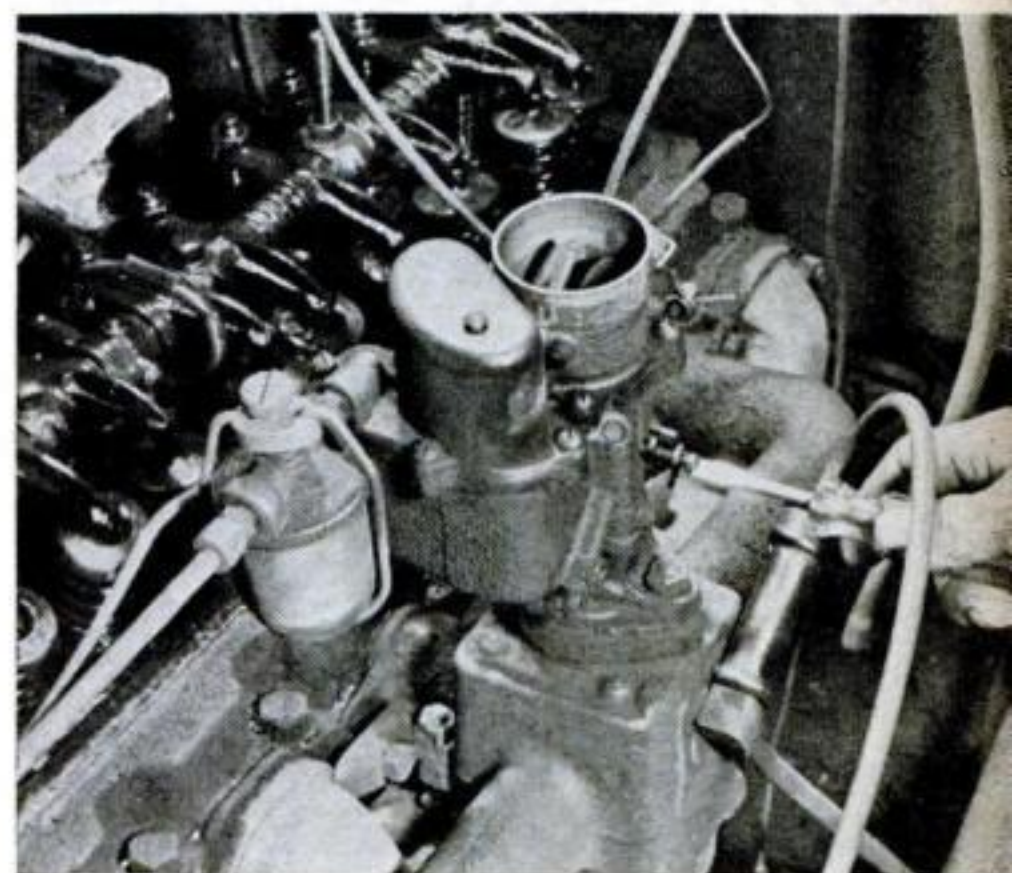
7. Ignition timing is adjusted by attaching a neon light to No. 1 plug, setting the octane selector at zero, and rotating distributor to line up flywheel mark while the engine idles.



8. Valve tappets were set at the recommended clearances with a feeler gauge and adjusting wrench as seen here. A new gasket was used when the rocker-arm cover was reinstalled.



11. Sloshed in kerosene to remove the dirt it had collected, the filter element of the air cleaner was blown dry. It then was dipped in clean oil, allowed to drain, and replaced.



12. Idle speed and mixture were both adjusted when the air cleaner was in place. (It was off here so as not to obstruct the photo). Notice hose connected to vacuum-test engine.

valve lash, fan belt, and voltage control; cleaning the air cleaner, crankcase ventilator, fuel filters, battery terminals, and spark plugs; checking the coil, condenser, distributor, vacuum spark advance, battery, automatic choke, and manifold heat control; and tightening the cylinder head, manifolds, and hose connections.

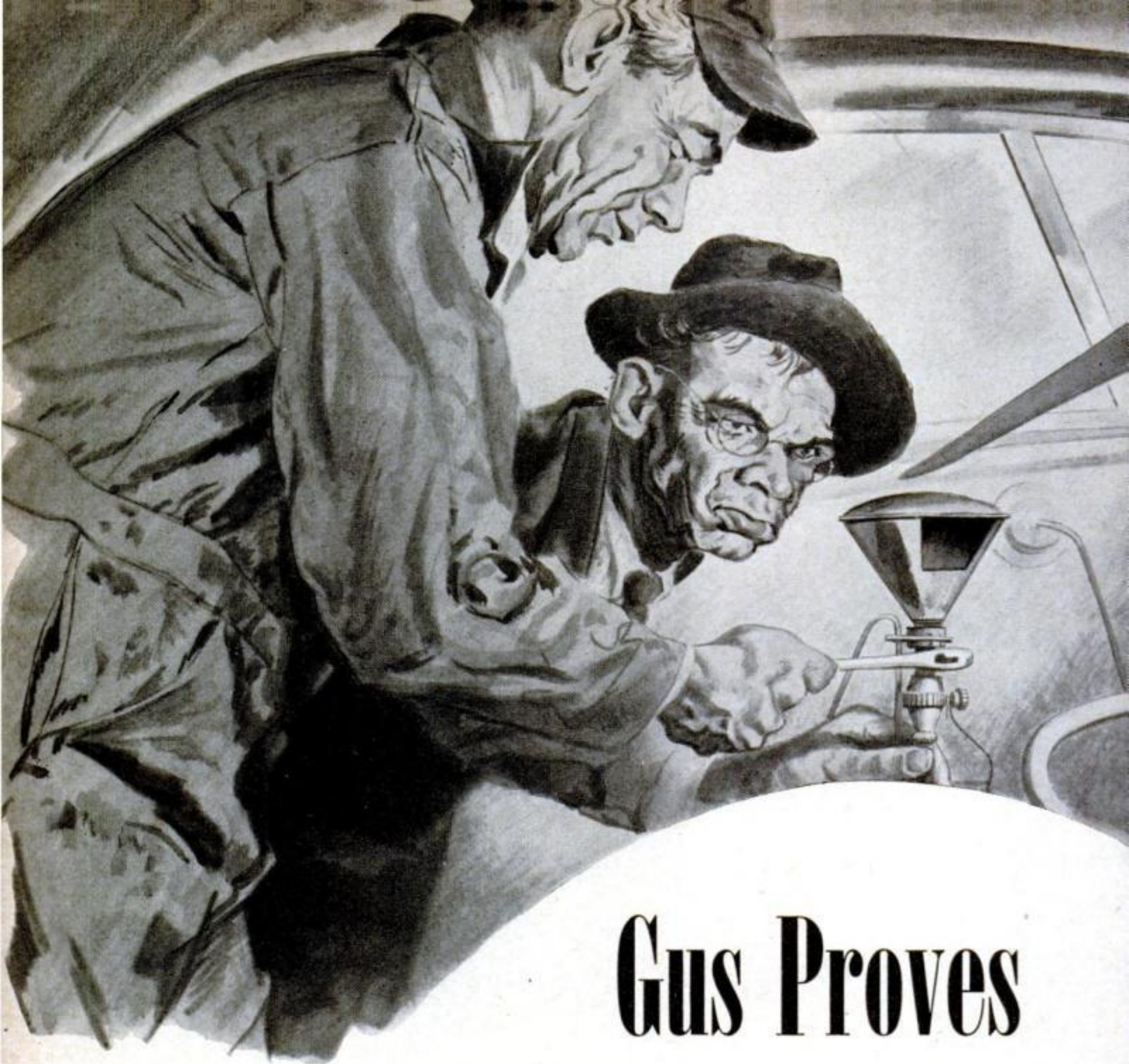
The testing equipment that's available also may extend the scope of the job. For instance, in the job presented here, the mechanic used an A. V. R. gauge to test the generator and voltage regulator (see top photo on page 168) after he had checked and cleaned the battery and terminals. In this shop the step is considered essential, for

a generator output higher than the recommended maximum has a tendency to burn the points or damage the generator.

Some mechanics consider a lot of fancy equipment unnecessary, and they undoubtedly can give you an excellent tune-up job without it. But when properly maintained and honestly used, the testing equipment now seen in many shops can work to the benefit of both you and the mechanic by showing unmistakably what's needed.

At the conclusion of the tune-up illustrated here, a trained mechanic took the car out for a short road test. When he was satisfied, the job was marked okay for delivery to the customer.

END



Gus Proves

Air and atoms may power cars some day, but skinflint Silas Barnstable discovers to his sorrow that the present models still need gasoline.

By Martin Bunn

STAN HICKS came into the Model Garage shop looking as if he had topped off his lunch with a glassful of vinegar. "That man," he announced, "is here again!"

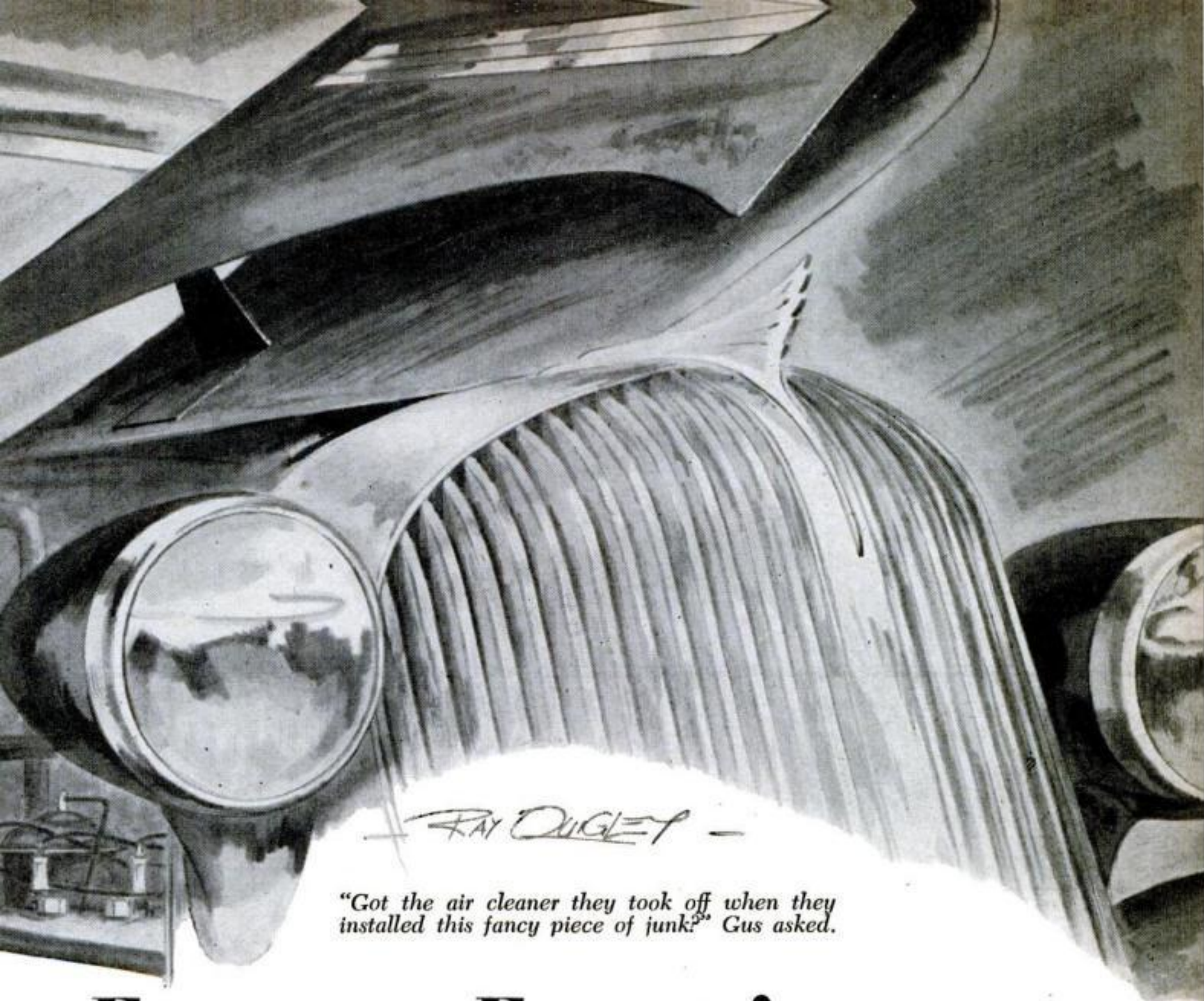
Gus Wilson looked up from the valve he was grinding. "What man?" he demanded.

"Silas Barnstable," Stan said. "Old Mister Pinchpenny himself. He hasn't been around here for six months—not since he squawked that we were robbing him because we billed him three-fifty for a four-buck job!"

Gus grinned. For some inexplicable reason he has a tolerant liking for the old retired farmer who has—and richly deserves—the reputation of being the tightest and most cantankerous man in town. "There's one thing in Silas's favor—he's always good for a laugh," he said. "But what's he up to? Why doesn't he come in?"

Stan took a look out of the window. "He's doing something to his car," he reported. "Got the hood up, and is listening to the engine. . . . Here he comes now."

Silas strutted in. As usual his manner



"Got the air cleaner they took off when they installed this fancy piece of junk?" Gus asked.

Economy Expensive

was that of a bantam rooster challenging the world, but under it, Gus felt, he wasn't altogether at ease.

"Mornin', Gus!" he cackled. "By jimminy, I ain't seen you in a dog's age! Got a trouble-shootin' job for you—provided you be a *leetle* reasonable about what you charge for it. Old friendship's old friendship, I allus say, and I'm willing to give you another chance."

"Which means," Gus said with pretended coldness, "that you've tight-wadded yourself into a mess you want me to get you out of. Well, that's all right with me, but you'll get charged the same as anybody else—no less and no more. That being understood, what's the matter with your car?"

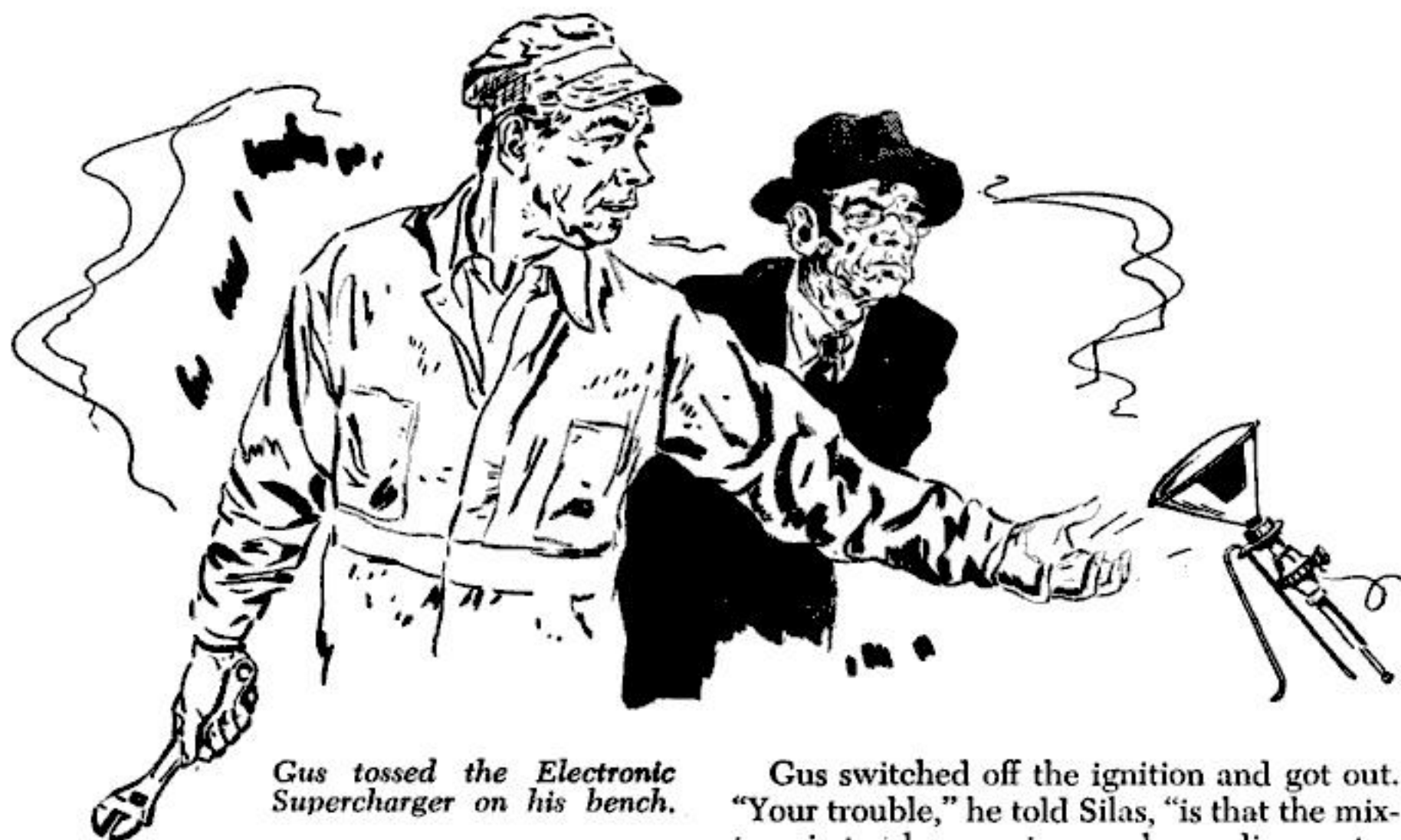
"Derned if I know what's the matter with

it," Silas grumbled. "It don't run the way it ought to, that's all I know. But it can't be anything serious—nothing that ought to cost much to fix."

"There's one way to find out. Drive it in." Silas drove his car into the shop and got out, leaving its engine idling—which it did with considerable missing. "Now jest listen to that," he complained. "She starts harder'n cold molasses and then does a lot of coughin' and sputterin'."

"Maybe it's the cut-rate gas you get down at that joint you do business with," Stan suggested.

Silas glared at him. Then he turned back to Gus. "I thought maybe you would have made some improvements around here since



Gus tossed the Electronic Supercharger on his bench.

the last time I was in," he said. "Such as firin' that nitwit grease monkey, for instance. . . . There's nothing the matter with this gas I've got in today—I bought it at that big service station across from the Post Office, and they charged me plenty for it."

"Well," Gus decided, "if there isn't something screwy with your ignition, the engine is being starved for fuel, and since you're using decent gas for a change, the fuel line must be partly clogged, or the carburetor is out of adjustment. I'll check—"

"No you don't!" Silas howled. "You ain't going to waste time monkeying around with the ignition or the gas line or the carburetor. Not if I've got to pay for it! They've all been gone over by a good mechanic, and he didn't find anything wrong!"

Gus gave him a straight look. "I'll do this job my way or not at all," he said tartly. "Take your choice!"

Stan's snicker didn't make it any easier for Silas to give in, but after half a minute of grumbling he told Gus to go ahead "your own fool way."

GRINNING, Gus got into the car and pressed his foot down on the accelerator pedal. As the engine speeded up the missing got worse, and it began to cough and backfire in the carburetor.

He pulled the choke part way out. The missing and backfiring stopped, and when he eased the engine back to idling speed it continued to run smoothly.

Gus switched off the ignition and got out. "Your trouble," he told Silas, "is that the mixture is too lean—not enough gasoline or too much air. You haven't been fooling with your carburetor, have you?"

"Never even tetched it!" Silas disclaimed.

"If you haven't changed the carburetor adjustment," Gus grunted doubtfully, "the needle-valve or the float must have got out of kilter. Or maybe there's an air leak in the intake manifold."

Gus raised the hood. He leaned over to examine the carburetor, but immediately straightened up with an expression of deep disgust on his face. "What the dickens is *that*?" he demanded, pointing to an oddly-shaped tin can where the air cleaner should have been.

"Newest thing out!" the owner said proudly. "Feller that sold it to me called it the Save-Gas Electronic Supercharger. It's a fuel economizer, that's what it is. And it's cut down my fuel bills, by heck! Not as much as the feller claimed it would, but enough so it'll soon have paid for itself. After that it'll be a real money saver for me. I got a leetle laid by for a rainy day, but I ain't one to waste when I can save!"

"I'll say you're not!" Gus agreed with real feeling. "How long have you had this do-funny on your car?"

"'Bout a month," Silas told him.

"And how long has your engine been missing and coughing, and starting hard?"

"Well," Silas admitted slowly, "'bout the same length of time, I guess."

"For a man with your head for figures, you add things up awful slow," Gus said,

tapping the fuel economizer not too gently with a wrench. "That's the cause of your trouble, and I'll prove it to you. . . . Got the air cleaner they took off when they installed this fancy piece of junk?"

"Yep—it's in the back of the car."

Gus disconnected the Save-Gas Electronic Supercharger, and tossed it contemptuously on his workbench. Then he reinstalled the air cleaner. "Now listen," he said, and got into the car.

The engine took off at a mere touch of the starter switch. When he stepped on the accelerator it speeded up smoothly, without missing or backfiring, and with the choke in. When he eased the pressure on the pedal it idled quietly and steadily.

Gus got out. "Convinced?" he asked.

The old fellow was red in the face and his faded blue eyes were blazing. "I've been cheated!" he howled. "If they won't give me my money back for that danged contraption I'll stand 'em a suit—I will, by heck!"

"You've been stuck, all right," Gus agreed unsympathetically, "but you can't do anything about it. You've got to admit that the Save-Gas Electronic Supercharger—which isn't either electronic or a supercharger—did just what the salesman claimed it would do. It reduced the amount of gas you used." He picked up the funnel-like contrivance, looked it over carefully, and handed it to Silas.

"You see how it saves gas, don't you? The opening of the can is toward the front of the car, so extra air flows into the carburetor. That leans the fuel mixture, and saves gas—just what the salesman said—so you can't claim that he misrepresented it. He just forgot to mention what the saving would cost in terms of performance."

"I'll get even," Silas snarled. "Those dirty cheats not only stuck me with this thing—they charged me for a trouble-shootin' job! If they don't make good I'll have the law on 'em!"

AFTER Silas had gone on his way, still breathing fire and vowing vengeance, Stan turned to Gus. "Say, boss," he asked, "are all the fuel economizers as useless as that one old Pinchpenny got stuck with?"

"I wouldn't want to say that," Gus hedged, "because maybe I haven't seen them all. But I will say that I've never seen one that would do anything a simple carburetor adjustment wouldn't do as well or better. And

the engineers at the Bureau of Standards down in Washington, who have tested a lot of 'em, say the same thing.

"Mind you, I'm only speaking of economizers, not performance improvers of the hot-rod, short-manifold type. These can sometimes make a sluggish engine wake up, while gas savers do just the opposite.

"This economizer is one of the better ones," he went on after he had fired up his pipe. "At least it makes good on its promise to reduce gas consumption. But unless the buyer's carburetor has been adjusted to give too rich a mixture, it does it by cutting engine performance.

"Most gas-saving gadgets work on the principle of adding more air to the carburetor mixture. If the carburetor has been set to give an unnecessarily rich mixture, an economizer will cut fuel consumption without spoiling engine performance by leaning down the too-rich mixture to normal. But carburetor adjustment will do that just as well, and cheaper. If the carburetor gives a normal mixture, an economizer will still reduce gas consumption, but the extra air makes the mixture so lean the engine'll buck and cough. If you don't mind poor pick-up and a little sluggishness, you can save just as much gas by installing a 'lean' jet on the carburetor."

"And go limping off at every light? Not me!" declared Stan.

"The average car owner, who's more interested in good performance than in squeezing the last possible foot out of each gallon of gas," said Gus, "should stick to normal carburetor adjustment. That'll feed a rich mixture when needed to give maximum power, and a leaner mixture when the engine doesn't work so hard.

"Most fuel economizers work on the air-adding principle, but a few have been developed which try to do the fuel-saving job in a different way. They don't spoil performance, but they don't save gas either. One that I had a chance to look at used an electric spark. It was supposed to make ozone to boost power, but the amount of ozone it produced was so small it couldn't be measured—which was lucky because ozone in quantity is a swell knock inducer!"

Stan nodded thoughtfully. "I guess it all boils down to this—you get what you pay for."

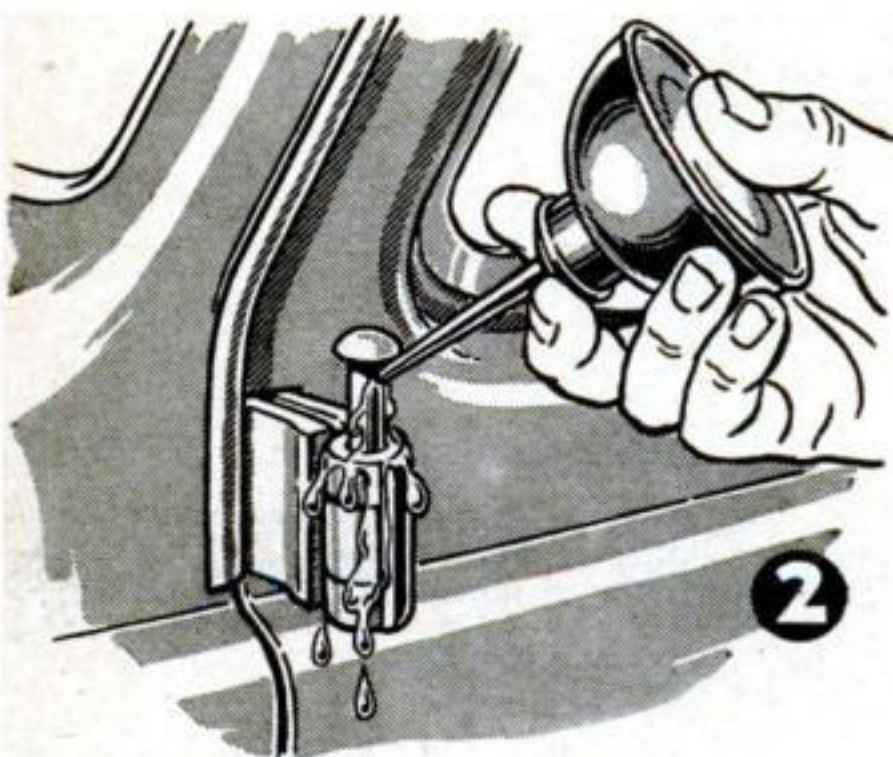
Gus stared at his assistant with mock surprise. "Once in a long while," he said, "you amaze me by being sensible!" **END**

Hints From the



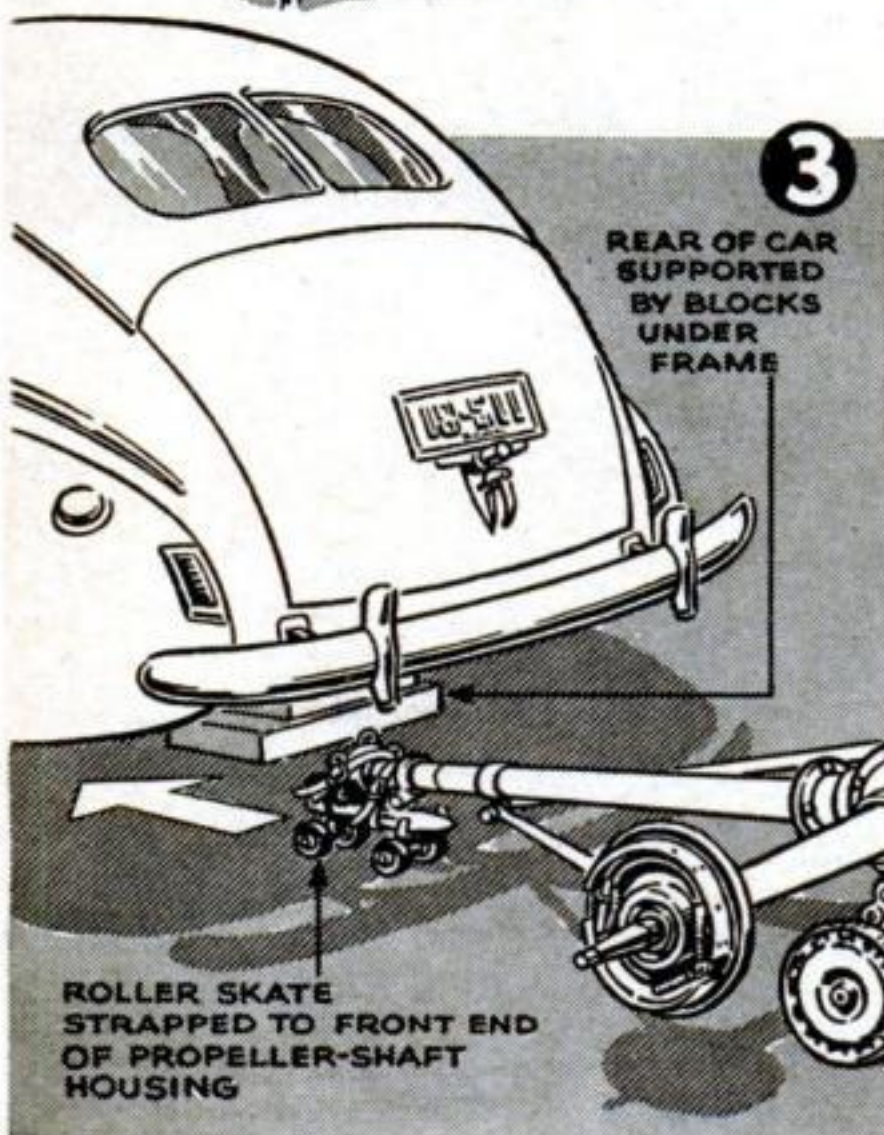
1. A flashlight is handy for repairs at night, but it may force you to work with one hand. A chap who stopped in the Model Garage had solved the problem neatly by keeping a heavy rubber band on the light.

With this, he can strap the light to his forearm, freeing both hands for work. He also keeps a supply of tape wrapped around the light—so he needn't hunt for it in the dark.



2. Drive Out Hinge-pin to Oil.

In the older cars with exposed hinges, Marion L. Rhodes, of Knightstown, Ind., finds it's best to drive the pin out halfway when oiling. Then apply a penetrating oil and allow to soak about five minutes. Unless the pin is loosened, even excessive oiling may not stop a persistent squeak.



3. Mower Used as Dolly. While doing a rear-end job in his backyard, G. A. Miller, Jr., of Atherton, Calif., found an unexpected use for his lawn mower. Since there was little room to work under the car, he wanted to do as much as possible of the job in the open. This, he figured, could include attaching the propeller shaft to the differential if there were some way of returning the assembled unit to position. He solved the problem with the mower and a roller skate.

Drawings by Stewart Rouse

DIFFERENTIAL HOUSING ROPED TO MOWER



Model Garage

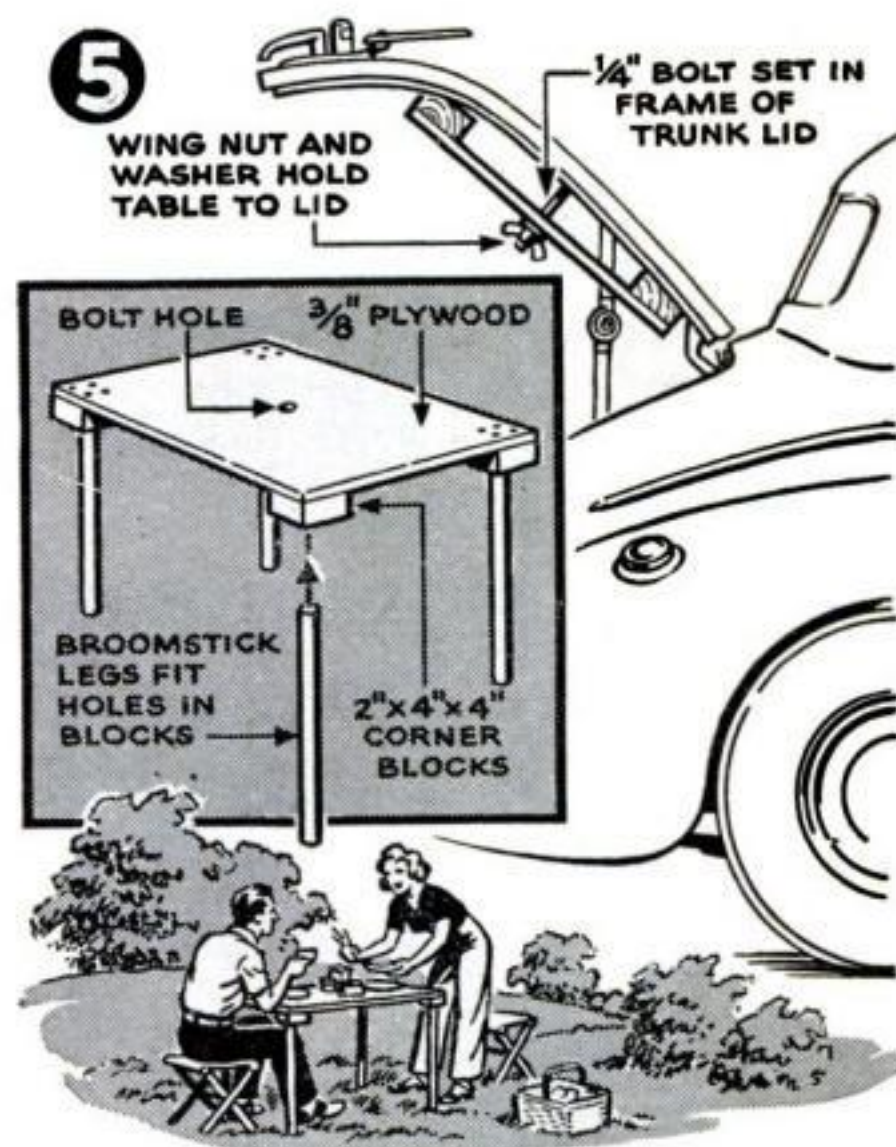
4. Paint the Hood Inside. Heat from the sun and engine may cause the finish on the hood to deteriorate. As a precaution, W. Van Sandt, of Long Branch, N. J., recommends making use of the fact that light colors reflect heat. White enamel or silver paint applied inside the hood will reflect part of the engine heat and keep the hood cooler.



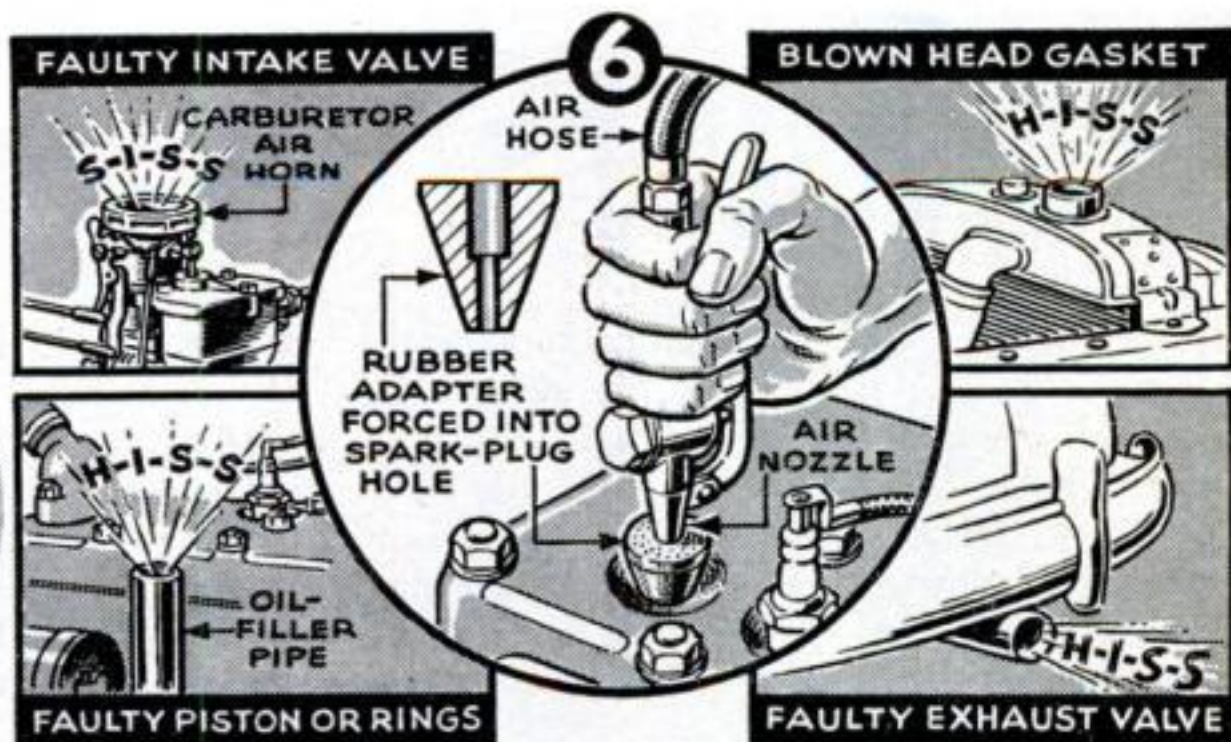
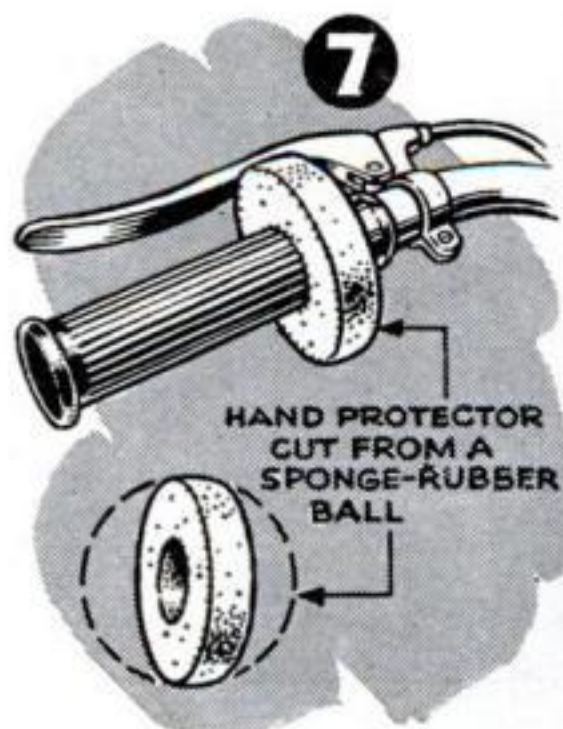
5. Table Always With You. Now that picnic time is here again, you may want to follow in the footsteps of H. C. Marhoff, of Chicago, and build this convenient table. When not in use, it takes up little space.

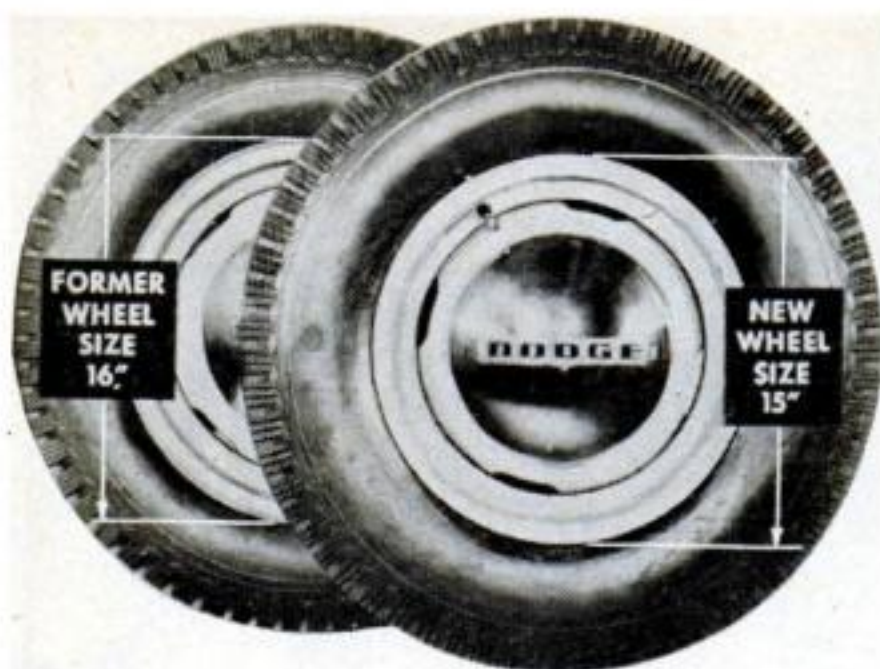
6. Air Spots Compression Leak. When an engine loses compression on one cylinder, Robert Brunt, of Lakewood, Ohio, diagnoses the trouble with an air hose. After removing the plug and setting the piston on firing position, he applies air to the spark-plug hole. If air hisses from the carburetor air intake, the trouble's in the intake valve; if from the exhaust pipe, in the exhaust valve; if from the oil filler, it's the piston or rings; if from the radiator, a blown gasket.

7. Cushions Rider's Hand. On long runs, the front-brake lever may chafe a motorcyclist's hand. A sponge-rubber disk slipped over the grip will prevent this.



Gus Wilson

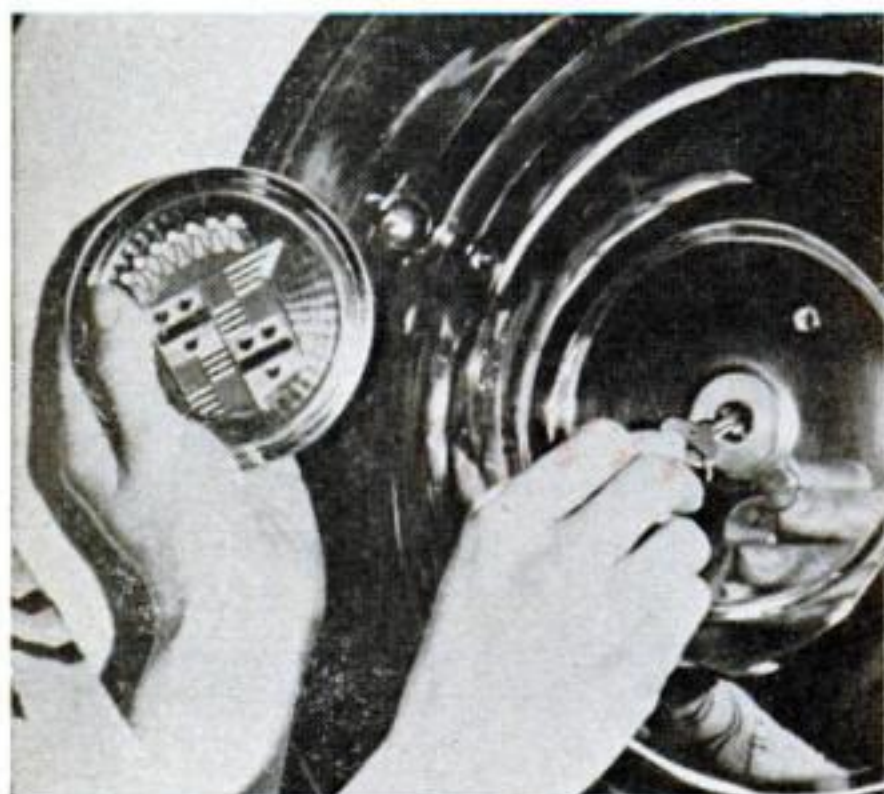




Rims Changed for New Tires

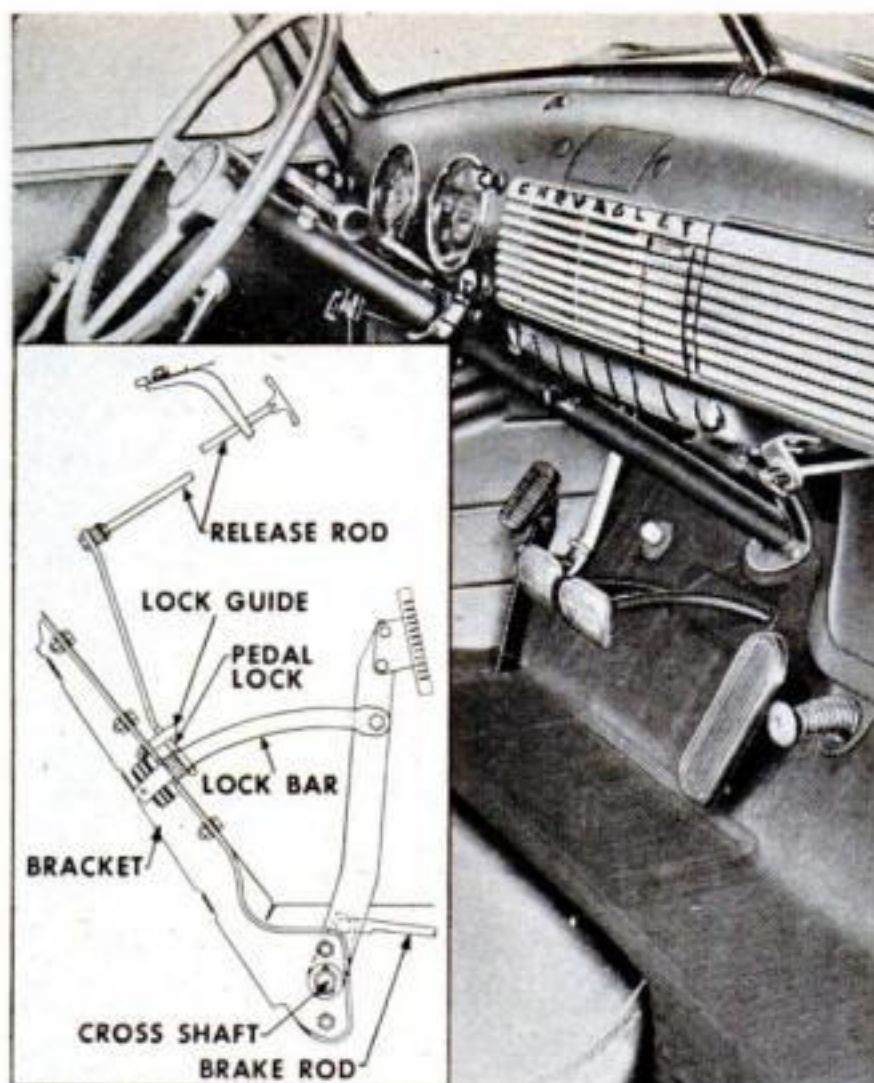
LOW-PRESSURE tires 7.10" by 15" have been made standard equipment this year on all Dodge passenger cars, and rim dimensions have been changed to suit—a reduction of 1" to a diameter of 15" and an increase of 1" to a width of 5".

Larger tires carrying greater air volume at lower pressure likewise are now being used on several other makes of cars. A softer and more comfortable ride, better road grip, and cooler running are among their advantages. Inflated pressure is 24 lb.



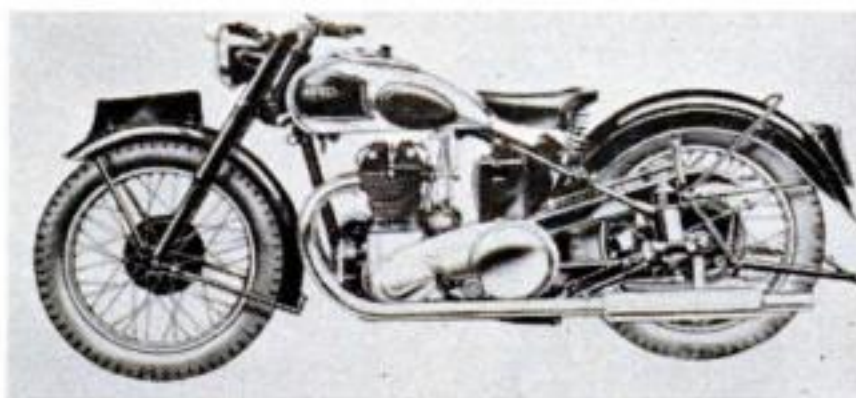
Lock Guards Your Hub Cap

CONCEALED by a decorative emblem, a lock in this new disk hub cap protects both the cap and wheel from theft. Made of stainless steel, the cap can be installed with just a tire wrench. At present it is available only for late models of three makes of cars, but the manufacturer—the Factory Tool Supply Company, of Beverly Hills, Calif.—has scheduled production for other makes. It's called "Lok-All®."



Parking Brake Applied by Foot

CHEVROLET has introduced a foot-operated parking brake on its 1948 light-duty trucks. Applied by depressing the pedal at the far left of the cab, the brake is released by pulling a hand rod mounted below the instrument panel. On all truck models with payloads up to 2,100 lb., the gearshift also is now located on the steering column rather than on the floor. Greater safety and operating ease are claims.



Ariel Introduces Twin Cycle

HERE is a new overhead-valve, vertical-twin motorcycle just announced by Ariel Motors, Ltd., of Birmingham, England. Hitherto Ariel has been known chiefly for its unique Square Four engine (PS, Aug. '47, p. 140).

The engine of the new twin has a capacity of 500 cc. (30.50 cu. in.) and a compression ratio of 6.8 to 1. Features include a one-piece crankshaft, four-speed transmission, and telescopic front forks. Equipped weight is about 415 lb.

Mechanics and Handicraft

REG. U. S. PAT. OFF.


Wall Rack for Spoons PAGE 181

Marine Bookcase Made of Pine PAGE 184

Put Midget Snap Switches to Work PAGE 192

How Cape Codders Build a Skiff PAGE 200

Sealing a Finish in Wood PAGE 230



Nice work, and you can do it. A spoon rack takes little material, may become an heirloom. Page 181.



Turned Plastic Cigarette Holders

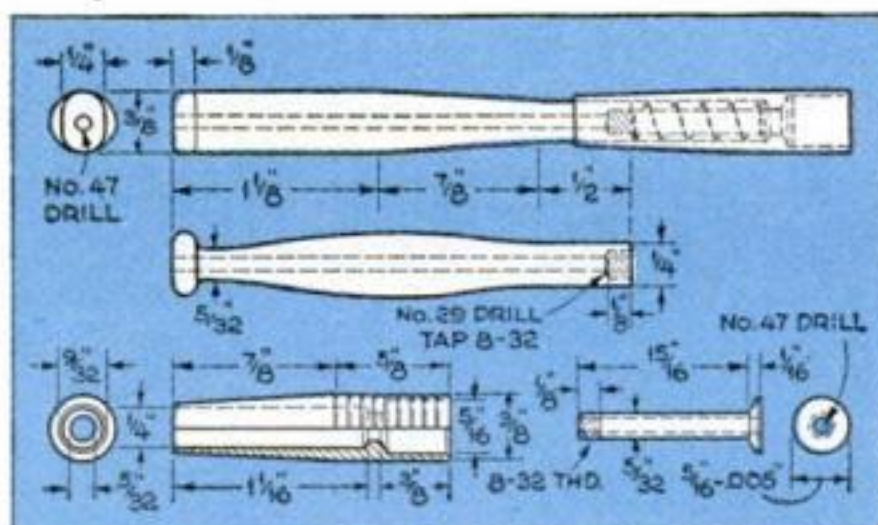
FOR pure relaxation, my favorite pastimes are smoking and simple lathe projects. What could be more natural than using one in the service of the other? Putting one and one together added up to these two plastic-and-metal cigarette holders. At the right is an ejector type; the one below is plain.

Aluminum is the best choice for the metal portion, while the plastic tip can be made of any clear or opaque stock large enough to form the blank. I think clear plastic looks a bit nicer, but it will show up mistakes in drilling the stem and the bore tends to discolor from the smoke. A pipe cleaner dipped in alcohol, however, cleans it quickly.

Centerdrill a $\frac{3}{8}$ " by $2\frac{1}{2}$ " plastic cylinder, (this applies to either type) then chuck a No. 47 drill in the lathe, and feed the blank into it with the tailstock. Go half way and repeat from the other side. Back it out frequently and clear off chips to keep them from scoring.

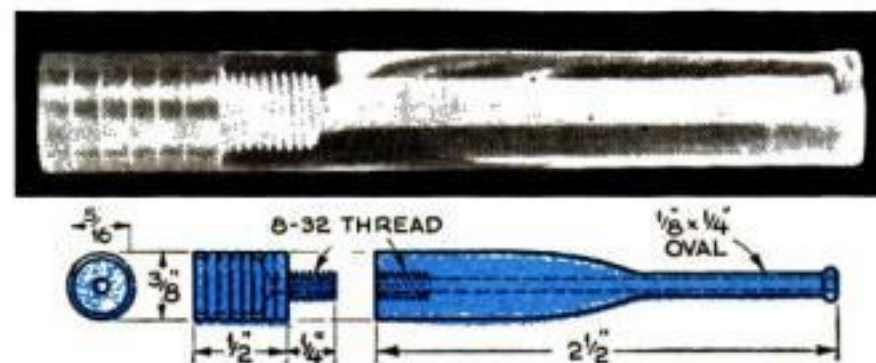
You can shape the oval mouthpiece quickest on a grinder. Take off the excess plastic until you are fairly near the final shape. From here on file it carefully, remove file marks with several grades of abrasive paper, and finish by buffing.

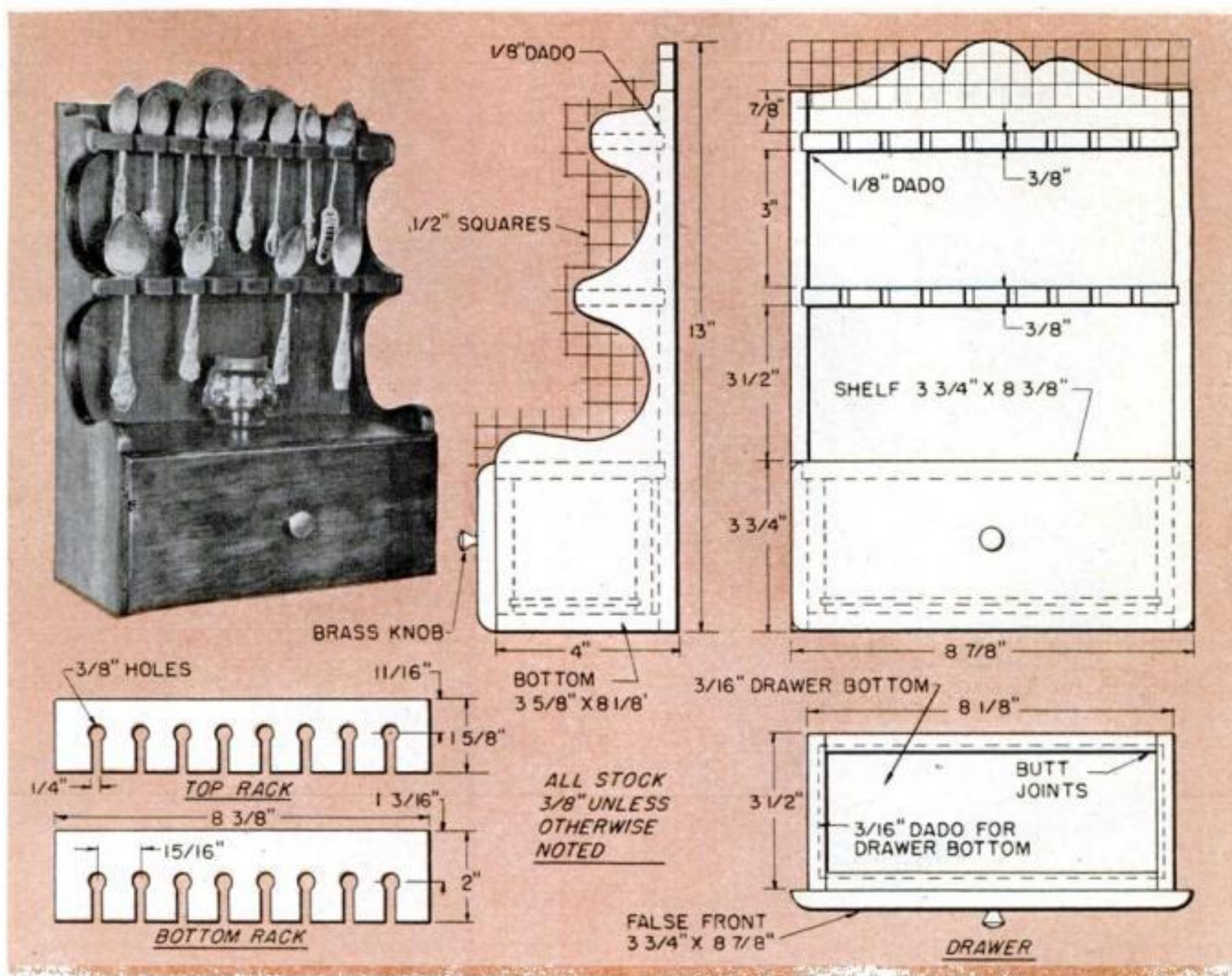
In making the ejector holder, take pains to get a sliding fit without shake between the mouthpiece and the $\frac{1}{4}$ " hole. The ejector



flange itself should be a nice sliding fit in the $\frac{5}{16}$ " diameter. Too tight a fit will interfere with the ejecting action, and too loose a one will dilute your smoke with air. In turning and drilling the outer piece, it's more convenient to make it with the tapered end toward the tailstock.

If you don't mind pushing the holder forward by hand, you can dispense with the spring.—Joseph F. Gréce, New York.





Cherry Rack Sets Off Your Spoons

ANY collection of silver spoons should be seen to be appreciated—not hidden away. Here's a neat little holder in which you may hang yours for display. The generous drawer at the bottom will take any extras.

Cherry was used to make it. The dark, rich finish usually given this wood is an effective background for the gleaming silver. However, it probably would be equally attractive in pine with an antique finish.

Except for the 3/16" drawer bottom, 3/8" stock was used throughout. All the pieces—sides, back, bottom, racks, and shelf—were first cut to the indicated rectangular dimensions. Before the back and sides were sawed

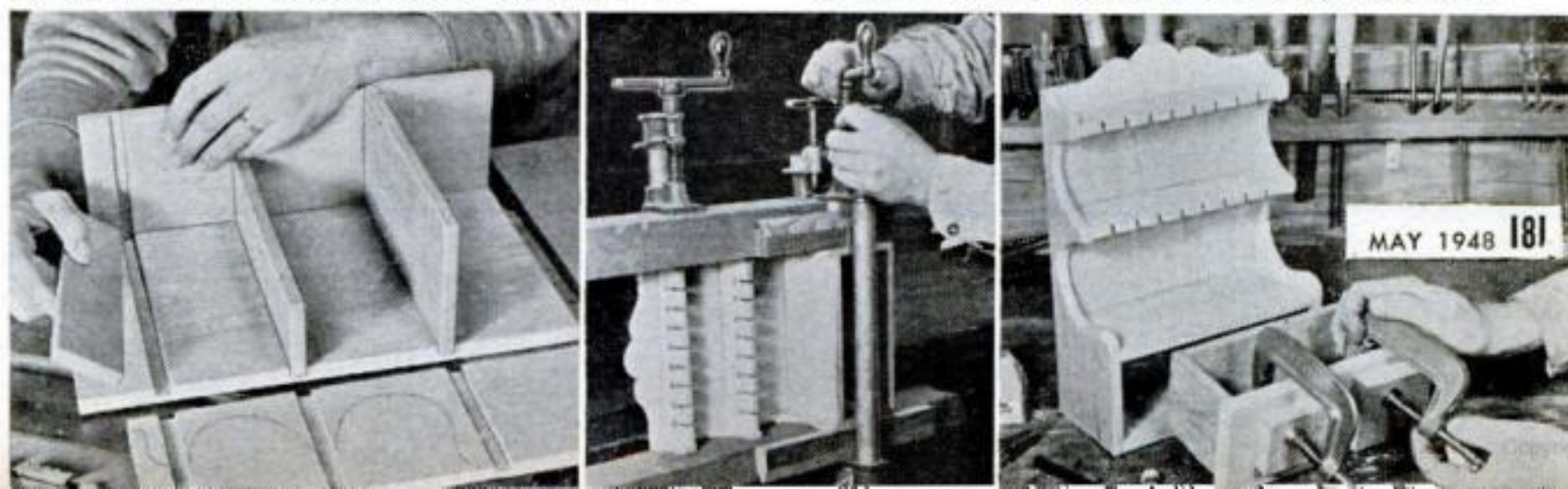
to the given patterns, 1/8" dados were cut in them to receive the 3/8" thickness of the racks and shelf. The bottom is butted within the sides and back.

Slots for the spoons are easily formed in the two racks by first drilling equally spaced 3/8" holes and then sawing 1/4" slots to them. Notice that the bottom rack is wider so that the upper spoons will hang in a different plane from those below.

The drawer requires little time. Use butt joints for the corners, but cut a 3/16" dado for the bottom. Glue on a false front and install a small brass knob as a drawer pull.—*Doris Aller, San Francisco, Calif.*

Cut dados in the back and sides after sawing all the pieces to rectangular dimensions. Here the pattern has been laid out on one side.

Clamp all the parts securely while the glue is drying. Sand them well before assembly. The edges may be rounded off as desired later.





AIDS TO MODERN LIVING



New Toasters. Placed in the side pockets of the toaster above, your first two pieces of toast will be kept warm while two more are timed to a turn and popped up when ready. The pockets are the idea of Paul H. Wilkinson, Flushing, N. Y.

Designed for crowded tables or even window sills, the other automatic toaster below has a single slot that takes two slices edge to edge. A slide-out tray catches all crumbs. It's made by Samson United Corp., of Rochester, N. Y.

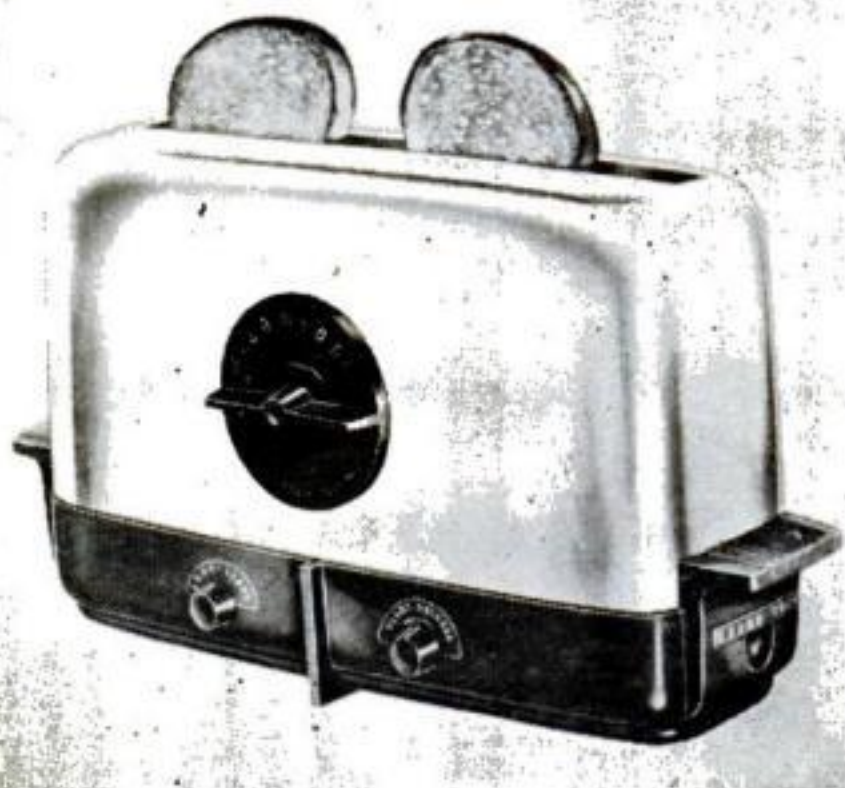
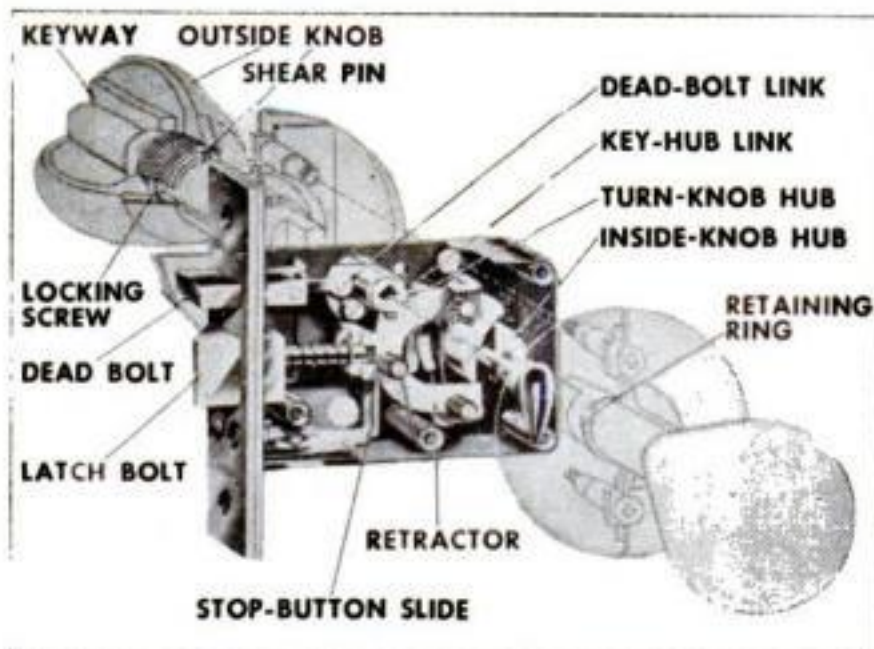
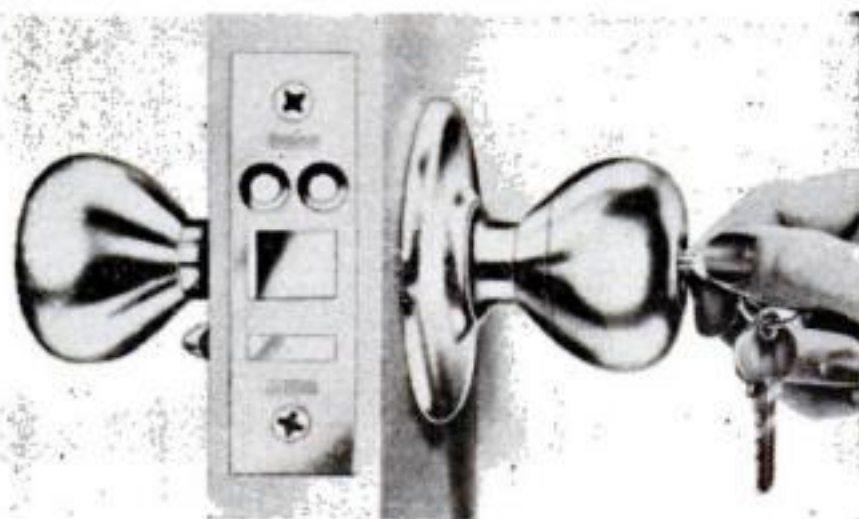


Table Drawer Slants. In a modern dining table produced by the Romweber Company, of Chicago, a special drawer for silver slants inward to make sitting at the table more comfortable. Closed, the drawer fits flush into the edge of the table.



Lock in Doorknob. Designed for the outer doors of small homes, this new lock operates with just a quarter turn of the key, releasing both the latch and dead bolt. A shear pin provides protection against forced entry. If subjected to extreme torsion, the pin gives way, allowing the knob to spin harmlessly, yet the regular key will open the lock. Inside, the dead bolt may be actuated by a turn lever. Sargent & Co., New Haven, Conn., manufactures the lock in a variety of finishes. A complete unit is priced at \$18. The drawing above shows some of the operating parts, all of which are mass produced to close tolerances to allow for easy replacement.

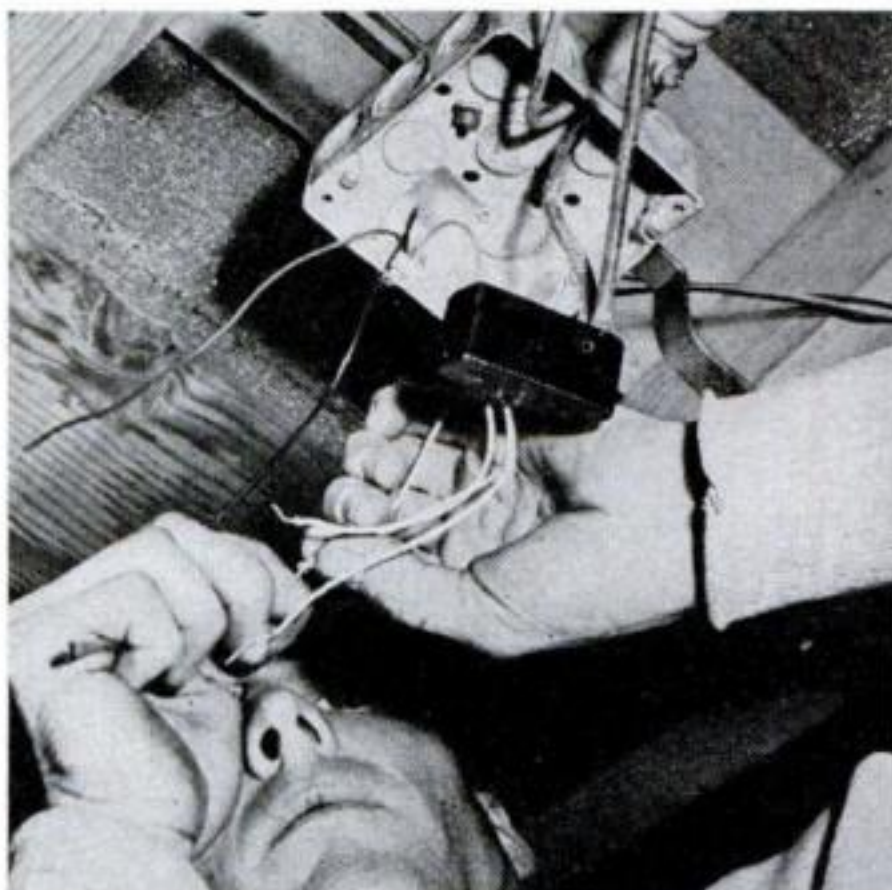
Take the Fireplace Along. A grill produced by Bennett-Ireland, Inc., Norwich, N. Y., may be set up anywhere in the



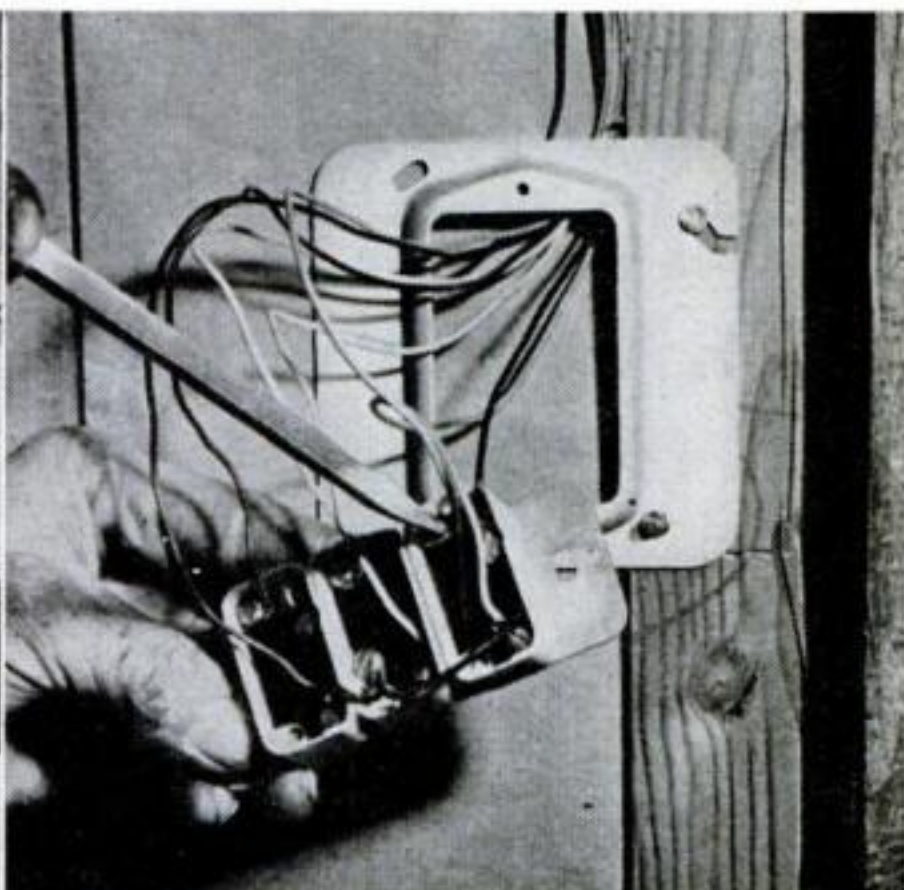
backyard—or may be taken apart and carried in your car when you go on a picnic. Since it rotates 360 deg., you can turn it so the smoke blows away from you. A shelf keeps ashes off the lawn and a heavy base prevents the grill from tipping.



Toasts Round Sandwiches. When closed with two slices of bread and a filling between, this gadget snips off the bread, leaving a round sandwich that may then be toasted in the unit. Called Toas-Tite ®, it's made by Bar-B-Buns, Inc., of Cincinnati.



A magnetic relay is located near each light. It's actuated by the low-voltage control circuit.

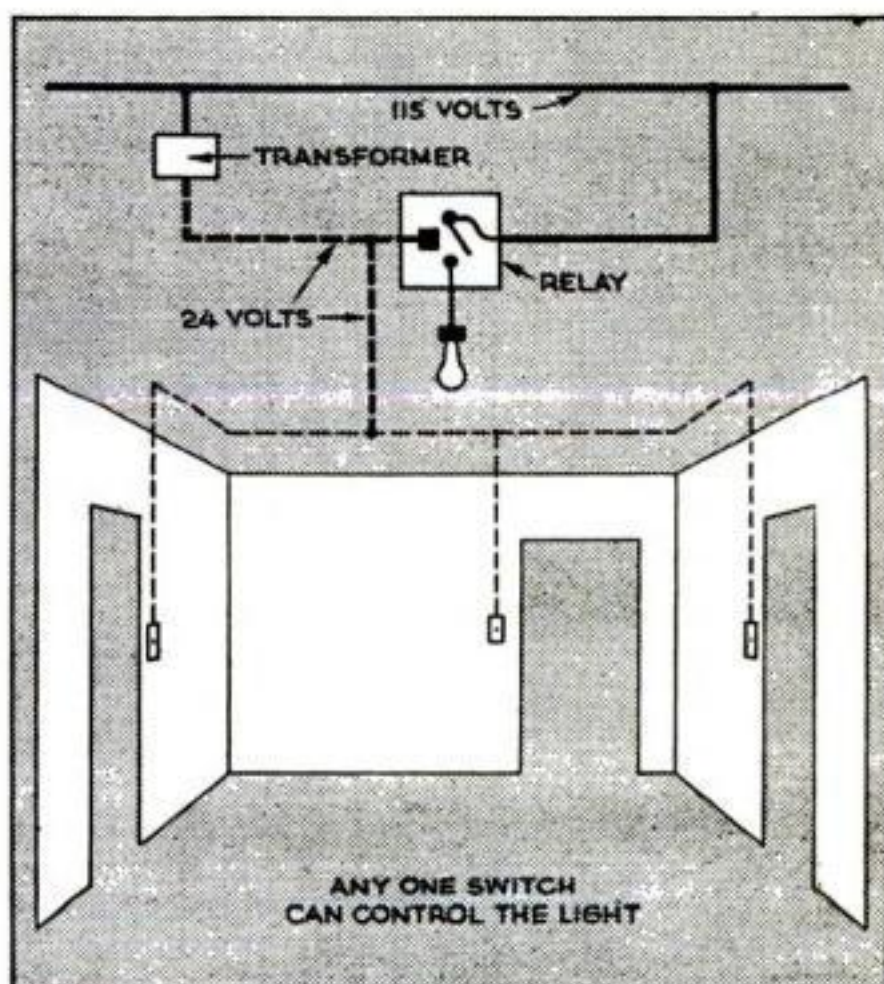


Light-gauge wires connect the switches to the relay. Low voltage makes conduit unnecessary.

Low Voltage Controls Lights.

In the conventional home wiring, there's usually only one switch to control each room light—even though the room may have several entrances. A low-voltage control system announced by the Square D company makes it possible to have one at every door.

Called Saflex ®, the system consists of a magnetic relay at each fixture to control the 115-volt circuit, and one or more S.P.D.T., lever-type switches in a 24-volt control circuit. Because of the low voltage, light-gauge wiring can be used instead of metallic conduits for the control circuits, thus reducing installation costs. Control wires can be run from each relay to as many switches as desired. Saflex ® also is adaptable to a master system that will enable you to turn on lights in several different rooms from one control point.



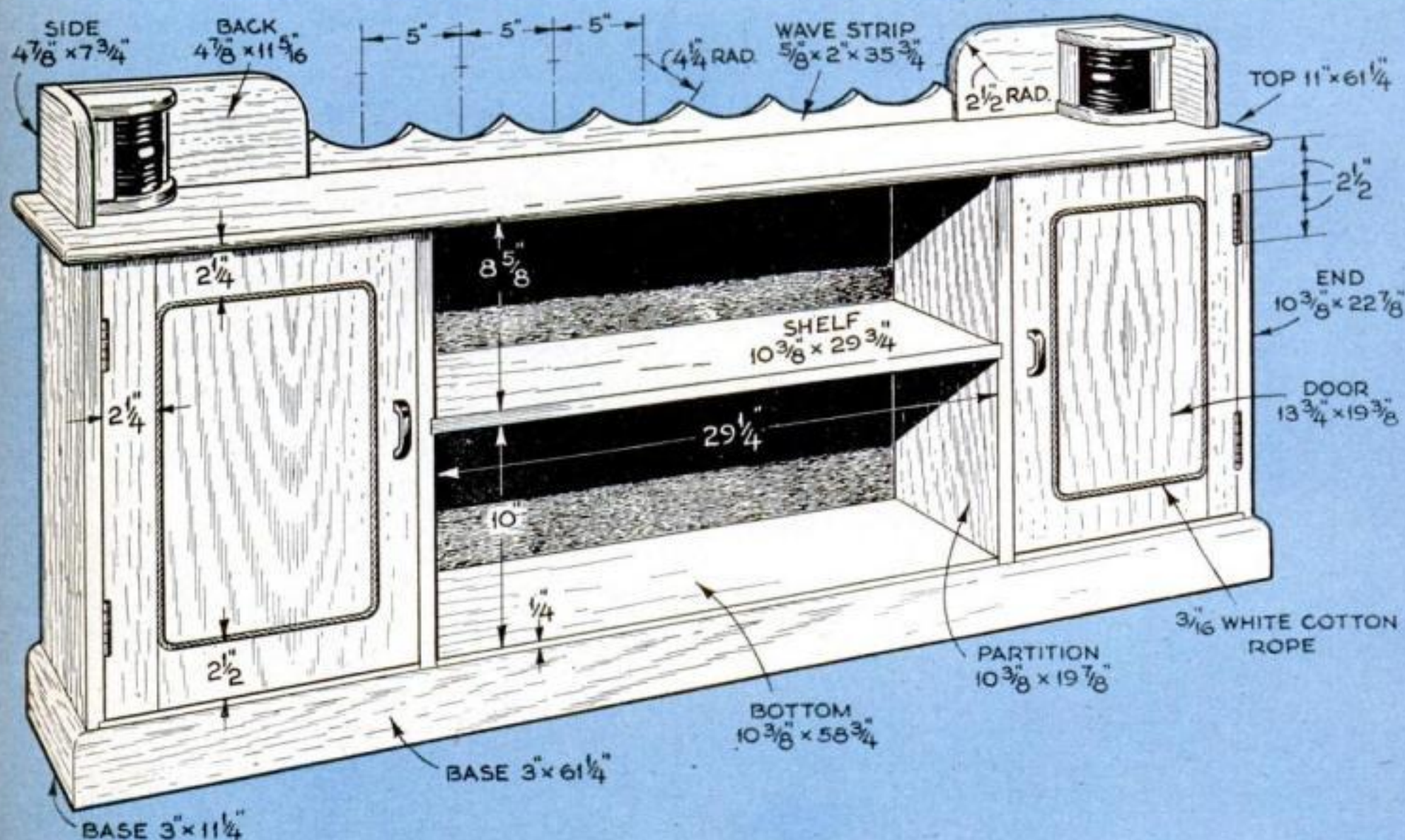
Marine Bookcase Built of Common Pine

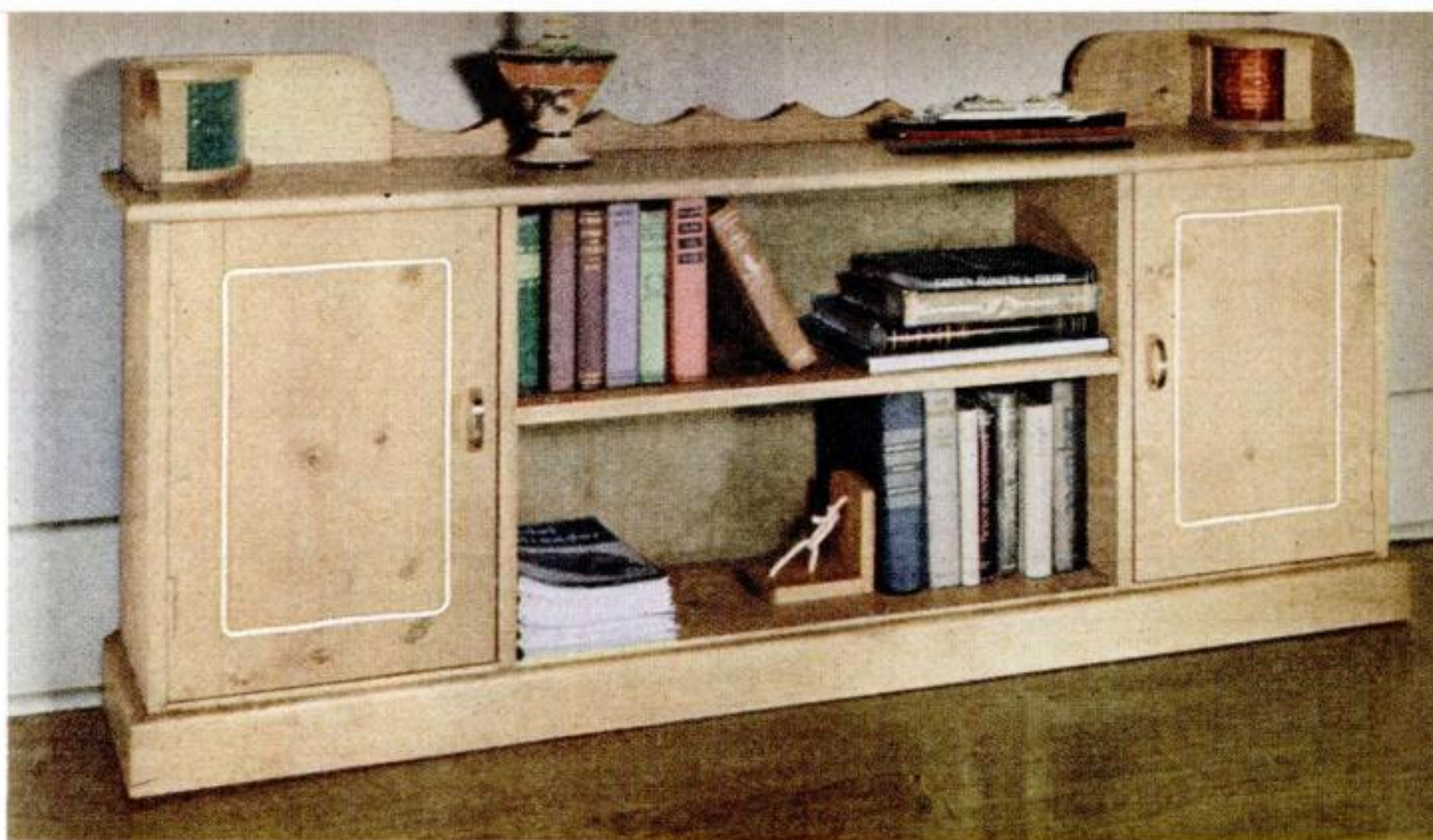
By Glenn A. Wagner

RED and green running lights, white-rope trim on the doors, and the wave pattern strip on the back add a dash of salt to the design of this nautical bookcase. The overall proportions are regular enough, however, for the unit to look at home in the living room as well as the game room or den. Either knotty or clear pine is appropriate to the seafaring theme.

Though power tools were used to build the model shown here and on the following pages, the job can quite easily be tackled with hand tools. Dadoes, for example, can be cut to uniform depth by clamping a wood strip along the saw blade $\frac{1}{4}$ " above the points of the teeth; rounded edges can be planed or even formed with rasp and sandpaper; and a coping saw will easily cope with the wave-pattern strip. Moldings on the edge of the top and base may be hand planed if you don't have a shaper or a circular saw equipped with a molding cutter. All dadoes are through cuts with the exception of the four blind dadoes formed in the underside of the top to receive the sides and partitions.

Buy one red and one green Fresnel lens and build mounts to hold them. If you have no router, you can omit the grooves at top and



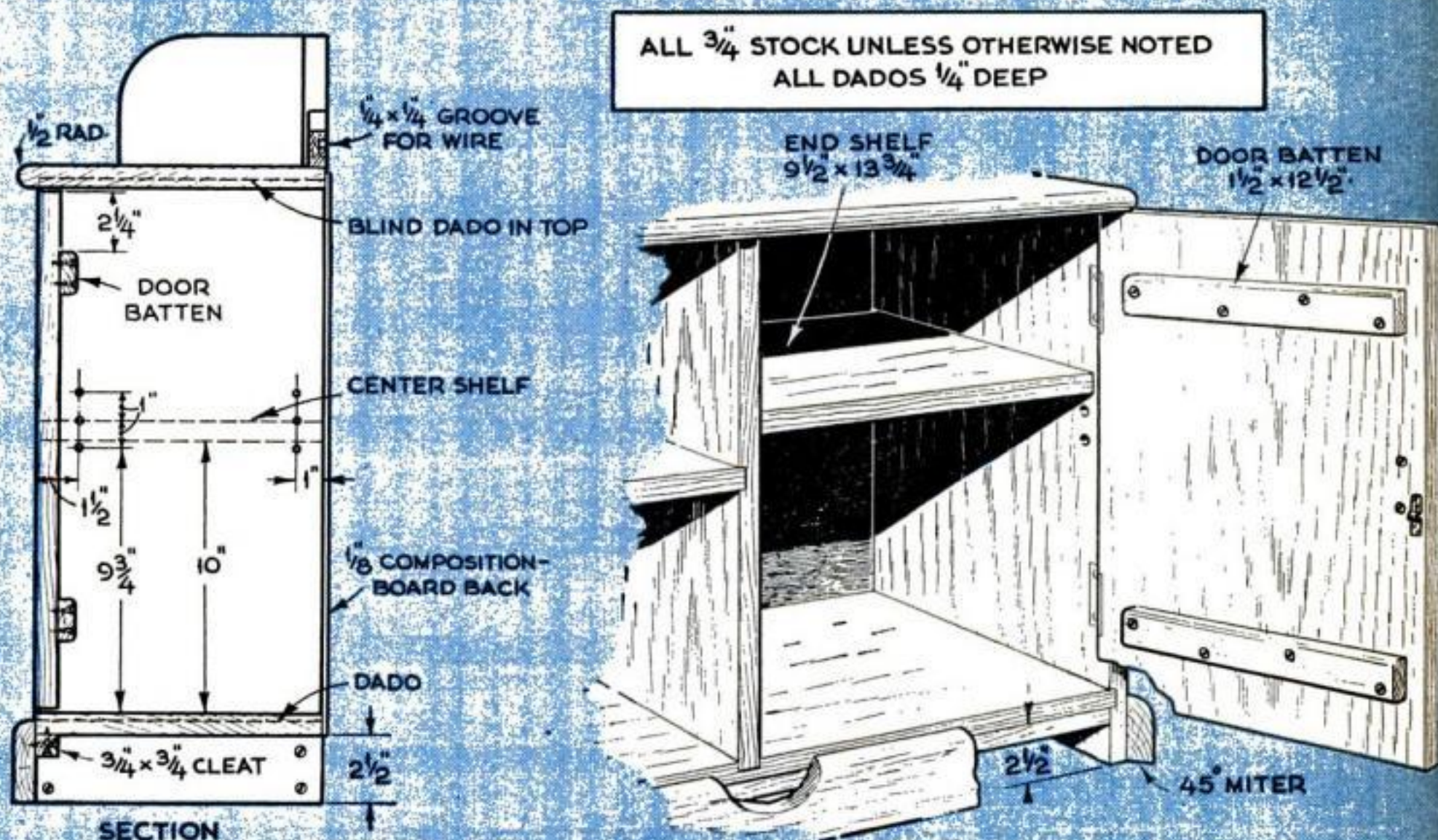


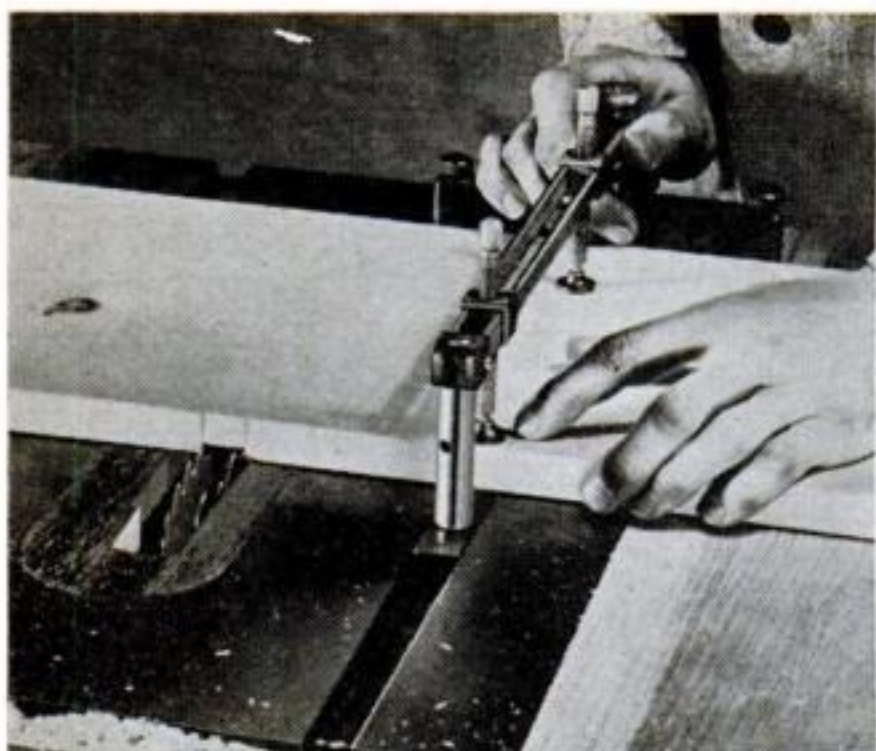
With its colorful, authentic air of the sea, this nautical bookcase is ideal for a man's den.

bottom and simply seal the inside lines where wood and glass meet with opaque tape or plastic weatherstripping.

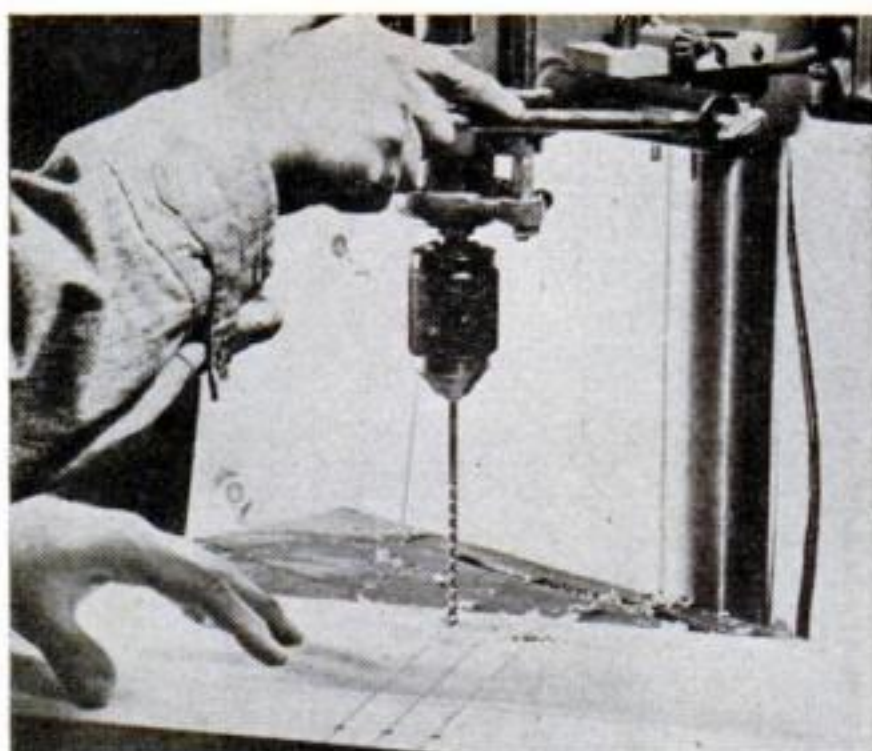
Sand all parts well, apply glue to the joints, and assemble with finishing nails. The heads can be countersunk and the holes filled. Brace the pieces square before the glue sets.

Three thin coats of orange shellac will give an appropriately soft finish. Rub each coat with fine steel wool before applying the next. Alternatively, a stain-wax finish can be brushed on, allowed to set, and the excess wiped off. Two coats of this, followed by one of wax, will give a soft, mellow appearance. Step-by-step photos follow. ➡





1. Dados are cut on a circular saw equipped with a dado head. Lay out the lines with the corresponding pieces clamped together. Clamp a stop to the table when cutting blind dados.



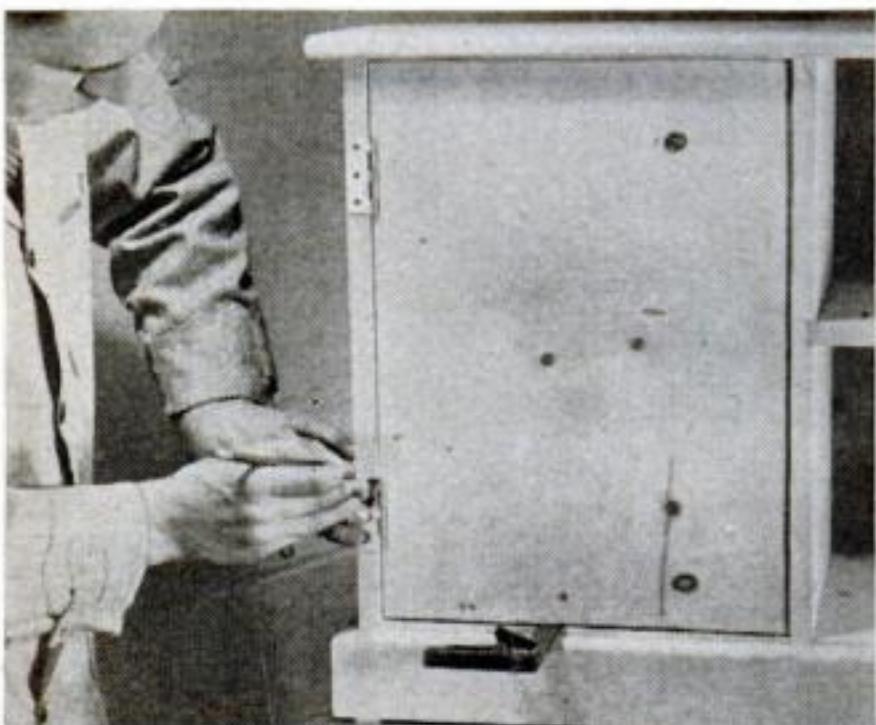
2. Holes for the movable shelf-support dowels in the end compartments are most easily made on a drill press. The depth stop is adjusted to about $\frac{1}{2}$ " and is uniform for all holes.



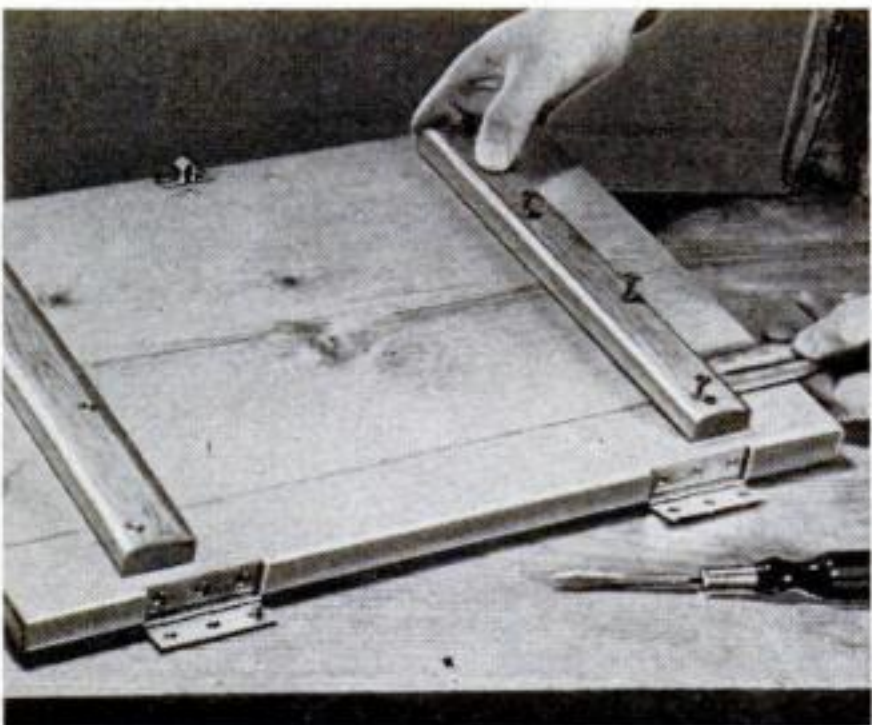
3. Assemble the shelf and center vertical partitions first; then attach the top and bottom. Turn the unit upside down and add the ends as shown. Joints are secured with glue and nails.



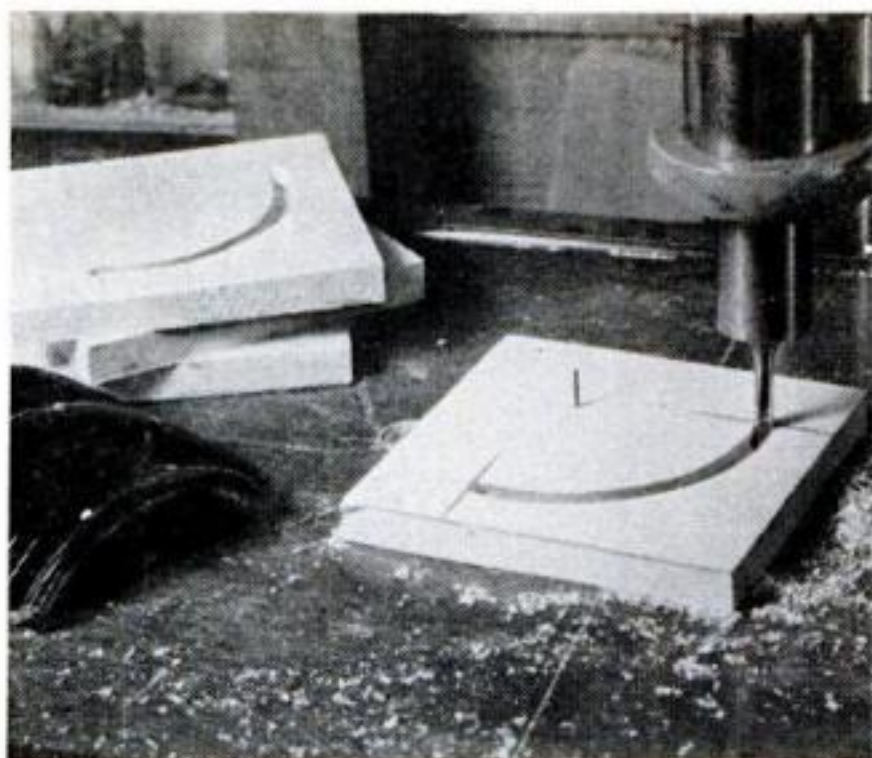
4. The base is fastened with wood screws. To hold the front part, attach a long cleat under the bottom shelf. Finishing nails are driven diagonally through the base and into the ends.



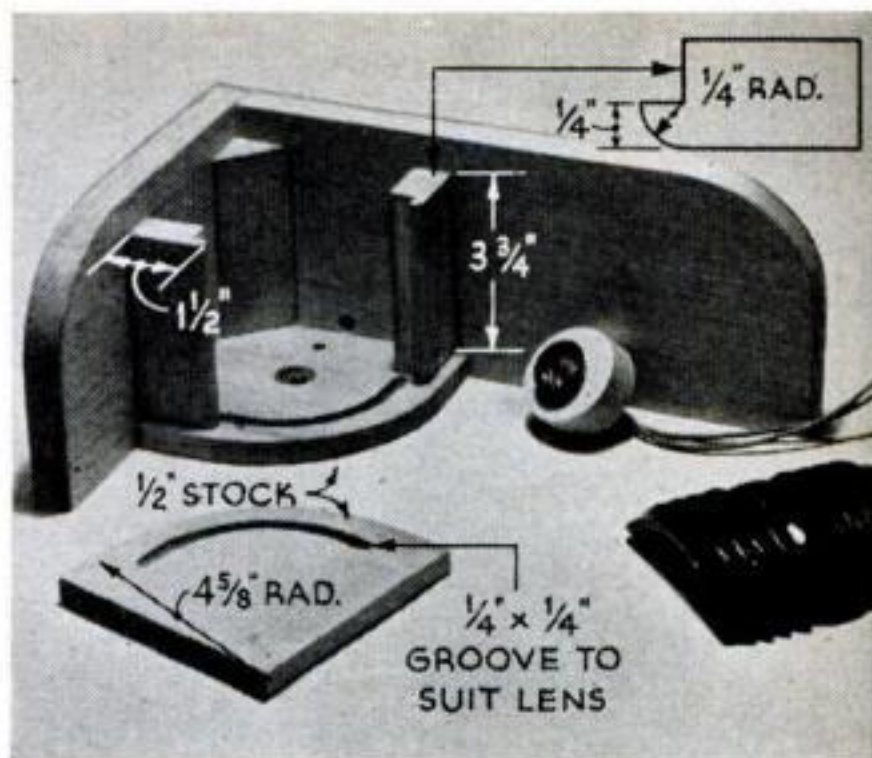
5. Allow clearance of about $\frac{1}{16}$ " all around both doors. Mount the hinges on the doors, mark off the proper positions as shown, and square the lines inside the endpieces.



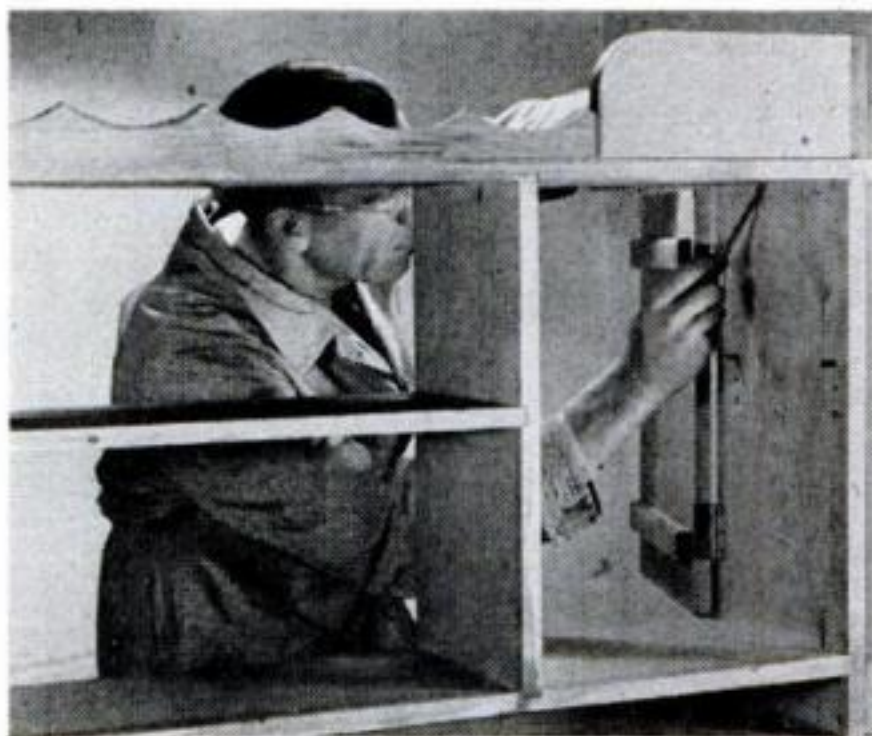
6. Gains, or notches, for the hinges are cut in the doors only; make them deep enough so that the second leaf will just lie flush with the edge. Attach pulls, catches, and battens.



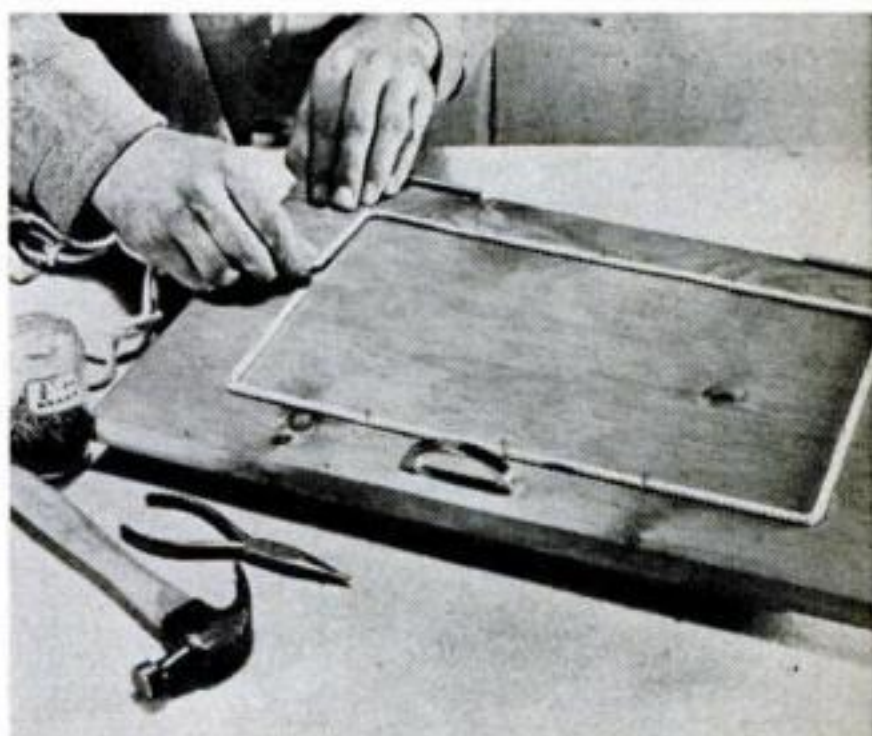
7. Grooves to fit the Fresnel lenses are made on a drill press fitted with a $\frac{1}{4}$ " router bit. The work is pivoted on a long brad inserted in a hole in an auxiliary drill-press table.



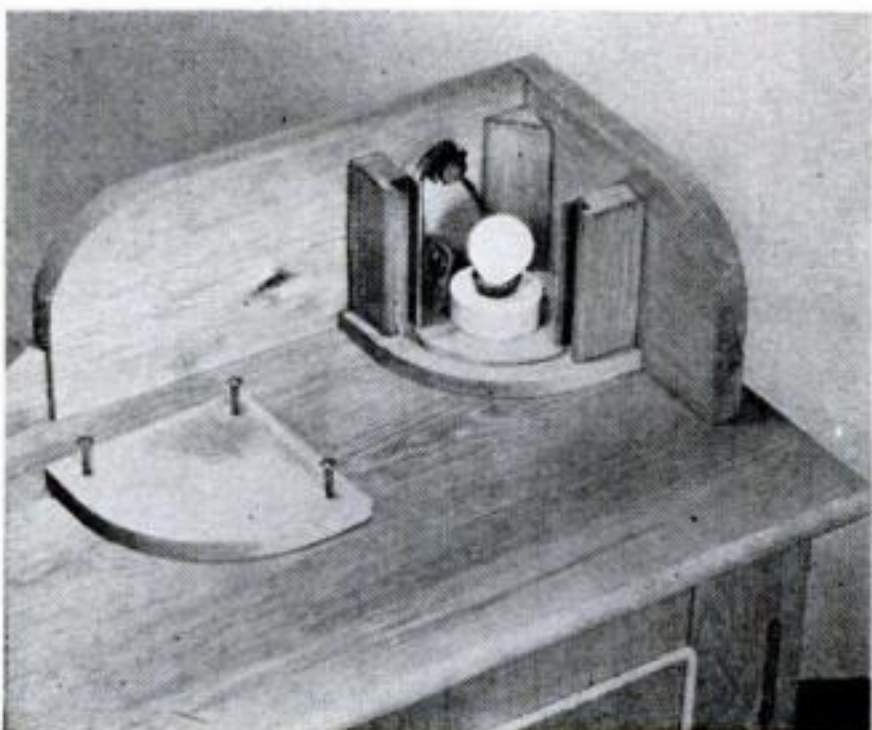
8. End and backpieces for the running lights are fastened to the lens base with brads, then the post and corner blocks are added. A wood disk holds the candelabra socket in place.



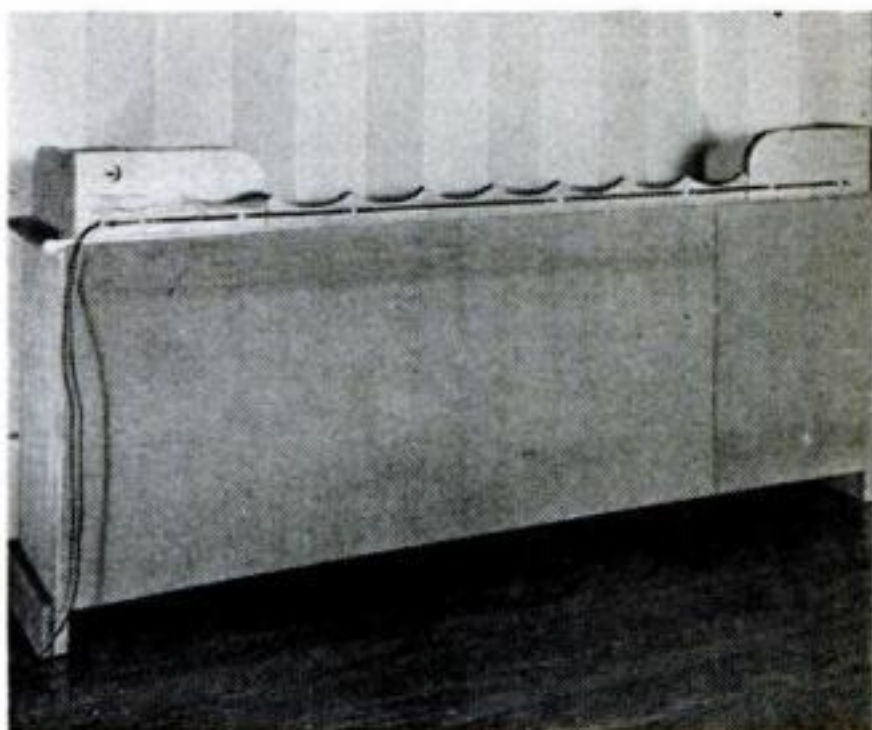
9. The wave-pattern strip and running lights are attached with screws driven from beneath the top. Before fastening them finally, mark and cut the $\frac{1}{4}$ " by $\frac{1}{4}$ " groove for the wire.



10. After the finish has dried, put the white cotton-rope molding trim on the doors. Stretch it taut and brad it first at the corners. Whip the ends to keep the rope from unraveling.



11. Detail shows construction of the running lights. The candelabra socket is fastened to a wooden disk that is secured to the base. The pushbutton switch is located above the light.



12. Wire is held in the groove with insulated staples. Place the switch wherever it is convenient. Here it is set in a counterbored 1" hole so that the button is flush with the back. **END**

Pie-Plate Candle Sconce Is a No-Solder Job



THERE'S a touch of the old West about this candle sconce that makes it just right for a play-room, closed patio, or informal dining room. Little equipment or experience is needed to put together a pair.

Soldering, so vital in most metalworking, is eliminated. As for materials, a ten-cent piepan and a tin can are the major items.

For tools, you'll want a hammer, a drill or punch, and a pair of heavy shears. Round-nose pliers are nice for bending crimped edges. Tin snips cut easier than shears, but the latter will do provided you don't expect them to stay sharp.

Cut both ends out of a large tin can with a can opener, and cut the cylinder open lengthwise (wire-cutting pliers will get through the thick edge). Next, snip off both beaded edges.

Draw paper patterns for the bracket, candle cup, and socket, paste to the tin, and cut out the parts. Try to make clean, continuous cuts; avoid "nibbling" at the edge, which leaves needle-sharp slivers.

Note that the bracket consists of two thicknesses, as it must be fairly stiff. Make the bends in a vise or by gripping the tin between two bits of wood with a C-clamp. Drill rivet holes in both bracket and pan, and rivet them together. Copper tacks make good rivets. If you prefer, you can use bolts and nuts.

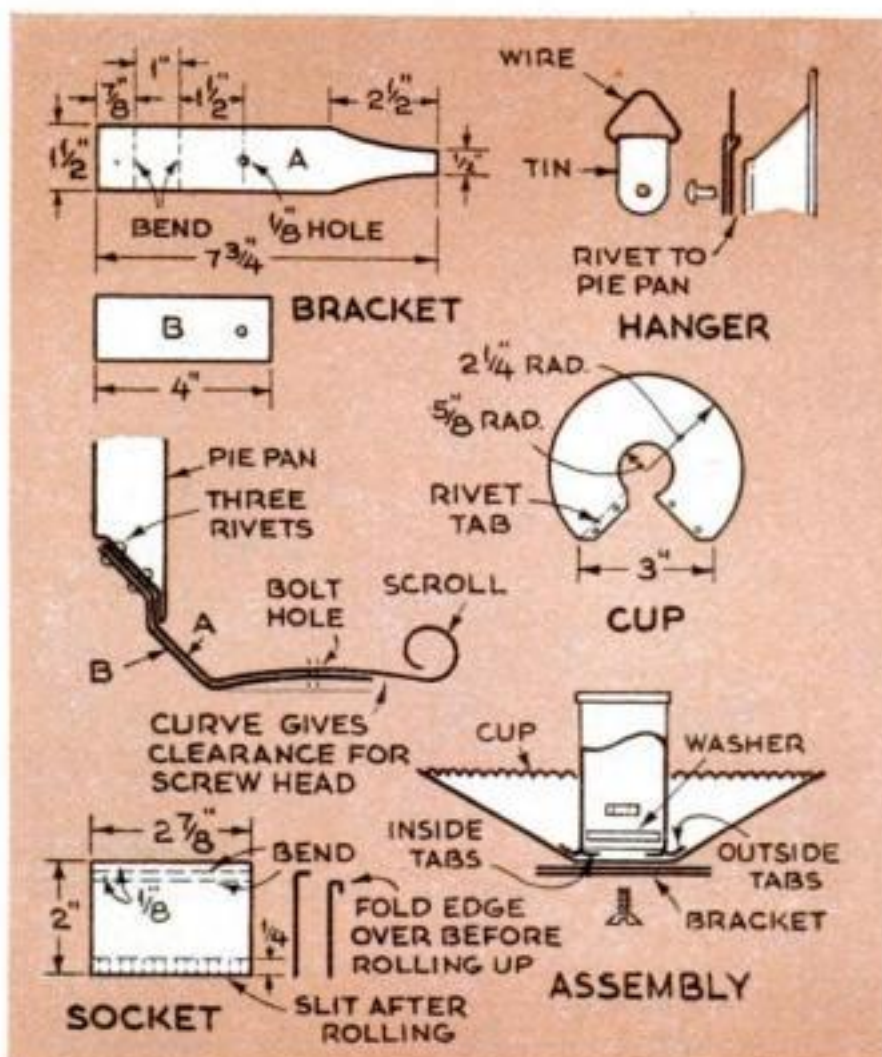
Shape the candle cup into a shallow cone with the fingers. You can leave the edge plain or crimp it with round-nose pliers. In crimping, bend the edge outward to produce a slight flare.

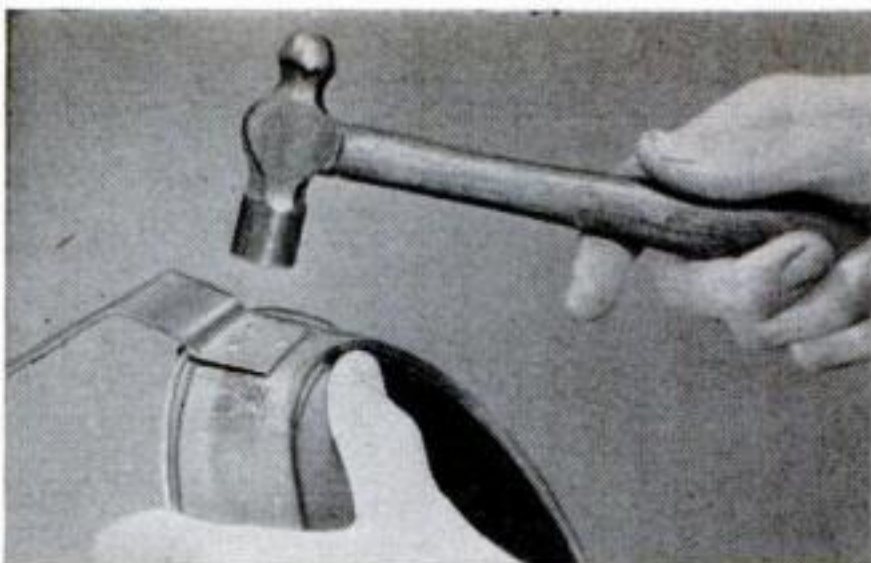


Hung on a wall or placed on any flat surface, this reflector makes the most of candlelight.

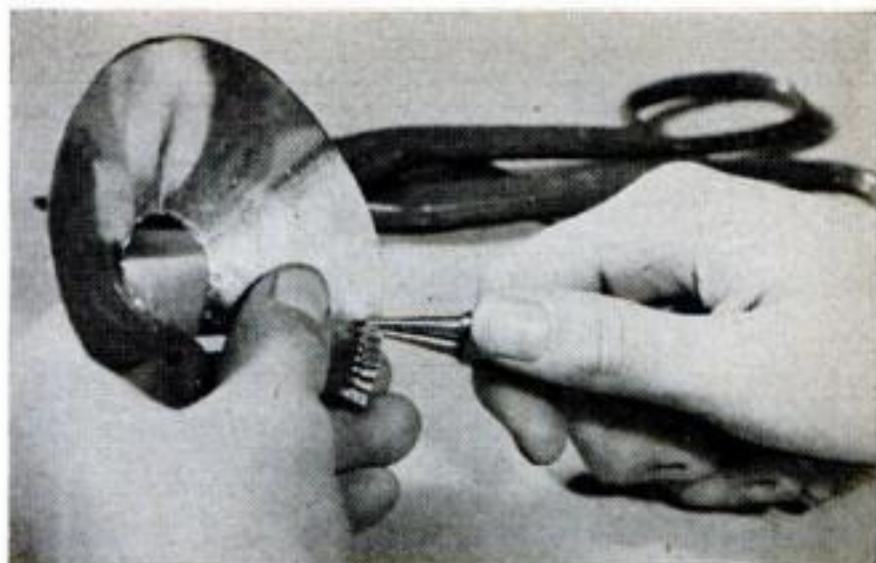
A neatly rolled edge on the socket can be formed by making two bends as shown in the drawing. If cleanly cut, a plain socket will also do. Bend the tin strip around a broom handle, leaving the seam open. Then carefully slit the bottom edge to a depth of $\frac{1}{4}$ " all around. Bend half the tabs in, and the others out.

Drop a washer into the socket, then a nut, and put the socket into the candle cup, open seam to the back. Push a bolt through the

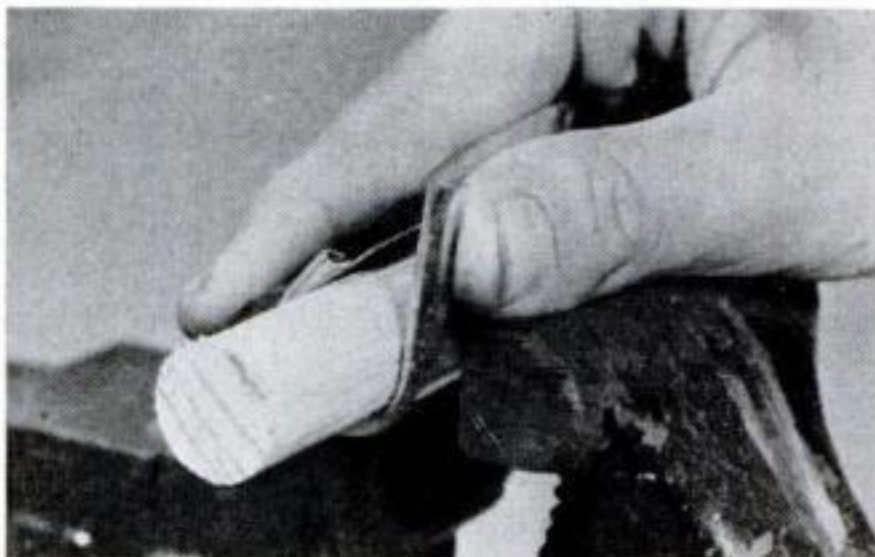




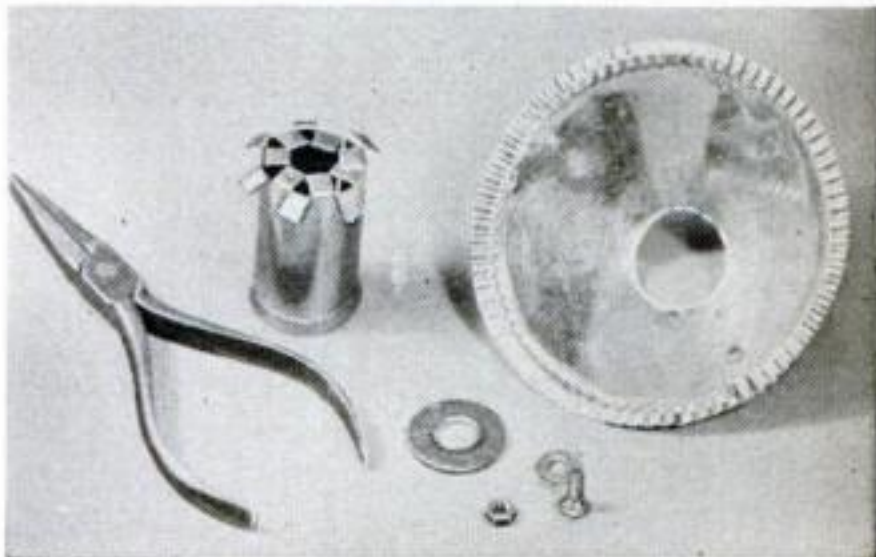
Copper tacks make good rivets for securing the bracket. Here stiff sheet metal was used. Thin tin-can stock should be doubled for stiffness.



The edges of the candle cup are crimped with round-nose pliers and bent down slightly for a flaring effect. Ends are riveted together.



A vise is needed to fold over the edge of the socket blank. Then the blank is rolled around a broomstick. The folded edge rolls itself over.



Socket tabs, alternately bent inside and out, lock the assembly. The washer clamps the inner ones; outer tabs clamp cup to bracket.

bottom of the bracket, adjust all the parts to stand straight and square, and tighten the nut. Rivet a hanging tab to the top of the reflector if you want to be able to suspend it from a wall hook.

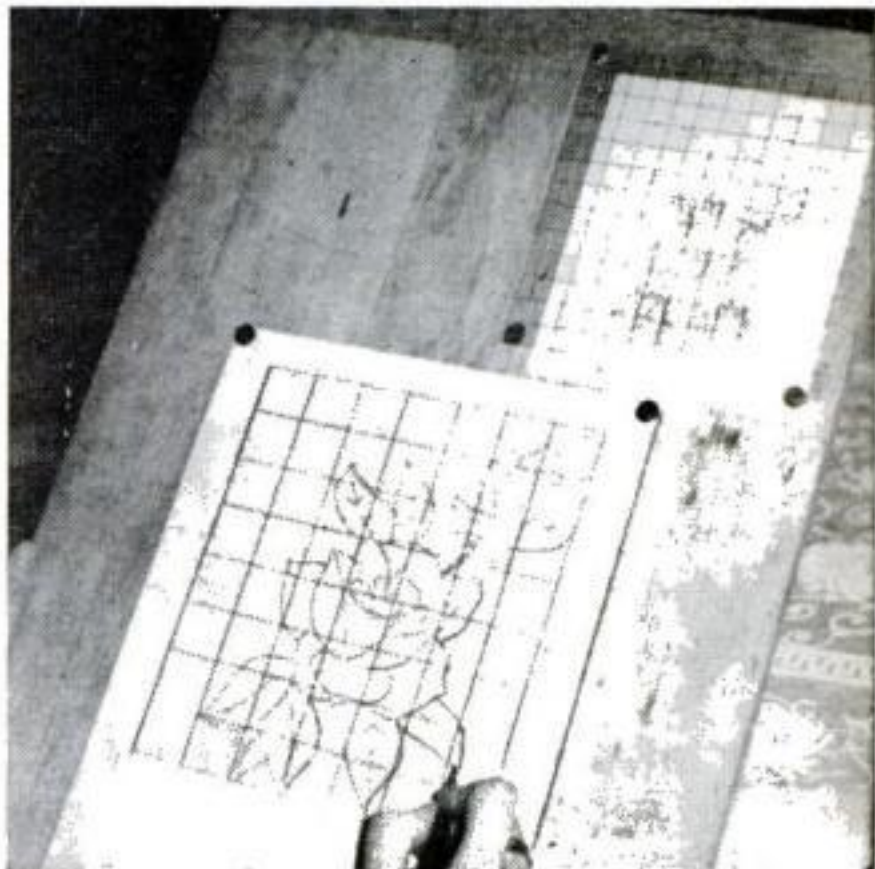
Apply enamel undercoater and a coat of

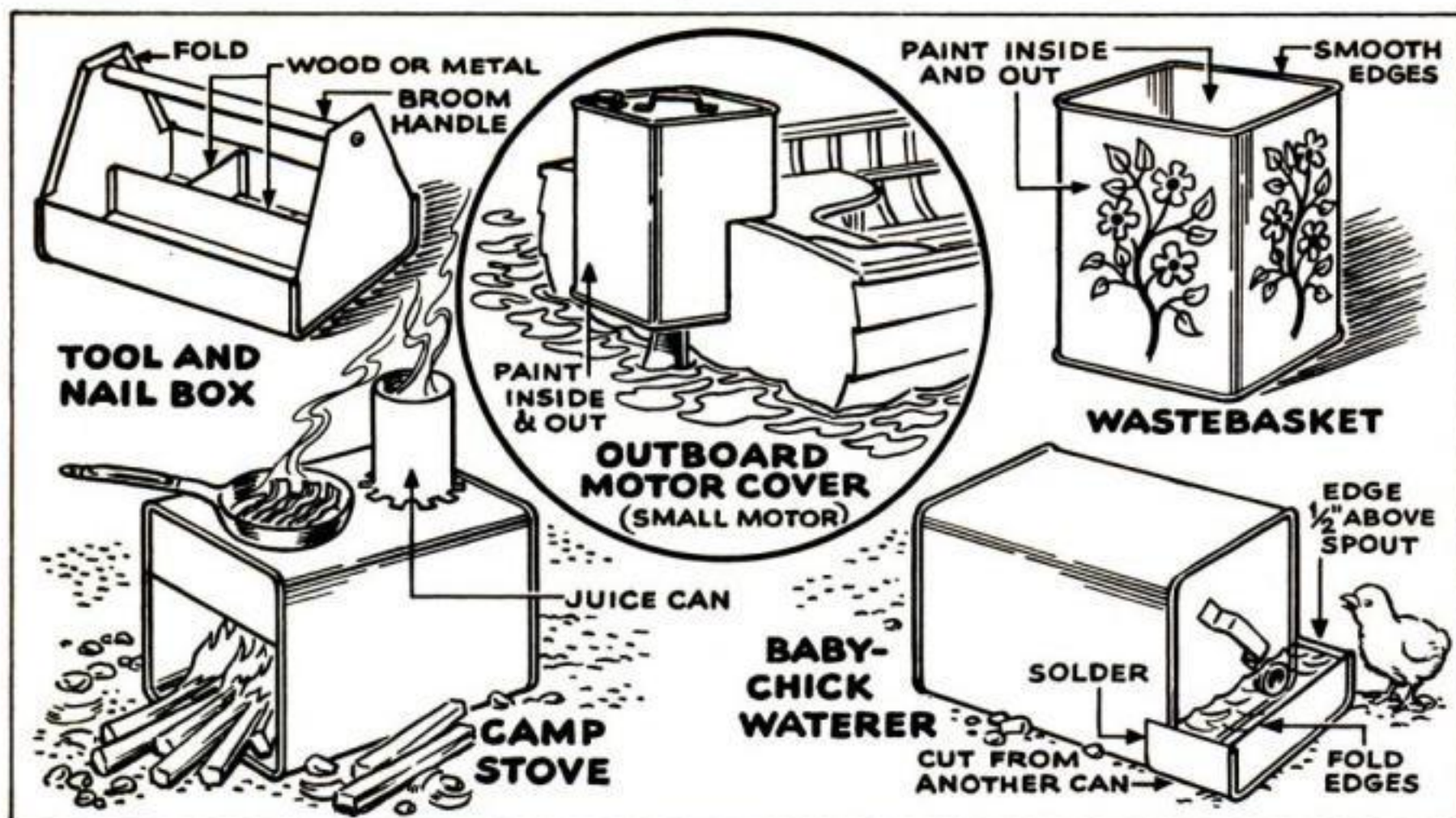
ground color to everything but the middle of the piepan, leaving this bright to reflect light. Then you're ready for decals or some freehand brushwork. Use colors in oil, squeezing a bit on a plate and blending with it a little clear varnish and turpentine.

Squares on Plastic Aid in Enlarging Drawings

A THIN sheet of clear plastic ruled with a grid of squares will come in very handy when you want to copy, enlarge, or reduce a drawing. Secure it on top of the original with tacks or tape. Draw a grid of squares of whatever size will give you the desired scale, and follow the drawing from point to point on the grid. No marks are made on the original, which is left just as it was by removing the plastic.

The size of the squares on the plastic is not critical. For most copying work $\frac{1}{2}$ " is about right. Scribe the lines carefully and not too deeply, using a sharp-pointed instrument. After the lines are marked, apply a little ink with a cloth pad, rubbing it into the scratches with a circular motion. Wipe off the surplus with a clean cloth.





New Ways You Can Use Old 5-Gal. Containers

SUCH liquids as motor oil, floor finishes, and spray materials frequently come in 5-gal. cans. With a little ingenuity, the empty containers can be made to serve a number of purposes around the home, farm, or camp.

Some are suggested above, but there doubtless are many others. For instance, just cutting away the top from one would give you an easy-pouring paint-mixing container. In most cases you can accomplish the

desired conversion with a can opener of the type that leaves a smooth edge, a pair of tin shears, a mallet, a metal straightedge for bending over edges, and perhaps a soldering iron.

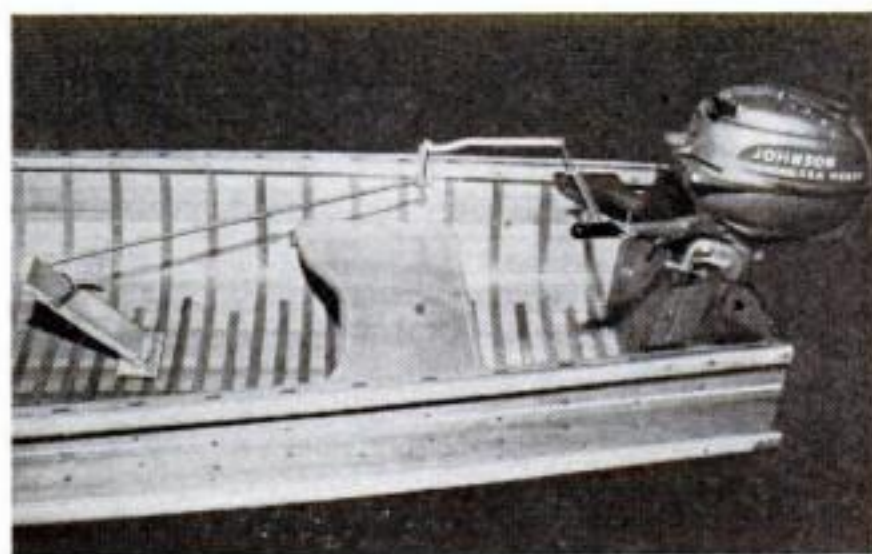
Since the chimney of the camp stove can't be soldered, cut tabs on the edge of a juice can, bend alternate ones out 90 deg., insert, and bend the others inside the large can.—*Ralph S. Wilkes, Keuka Park, N. Y.*



Trailer Hauls Boat to Water

WITH this trailer unit, you can haul a boat to a beach or stream, launch it yourself, and lift it out of the water—again by yourself—when you're ready to go home.

Simple leverage does the job. Straddled by the trailer, the boat may be lifted or lowered with ease when the rear end of the drawbar is hooked into a suspension unit mounted inside the craft. A hook at front holds up the bow of the boat for hauling. Holsclaw Bros., Inc., Evansville, Ind., makes the trailer in three sizes.



Pedal Lets You Steer by Foot

EQUIPPED with a pedal and strap into which you hook your foot, an outboard steering control offered by the Northwest Marine Co., of St. Paul, Minn., enables a fisherman to keep both hands free while trolling, casting, changing bait, or landing fish. Operated either by pushing down or pulling up your foot, depending on the direction you want to turn, the control steers the boat through a bell-crank arrangement.

Midget Firewood Baskets Serve Candy and Cigarettes



PLACED on the coffee table, a pair of miniature firewood baskets in polished brass are sure to draw favorable comments. One may be used for cigarettes, the other for candy.

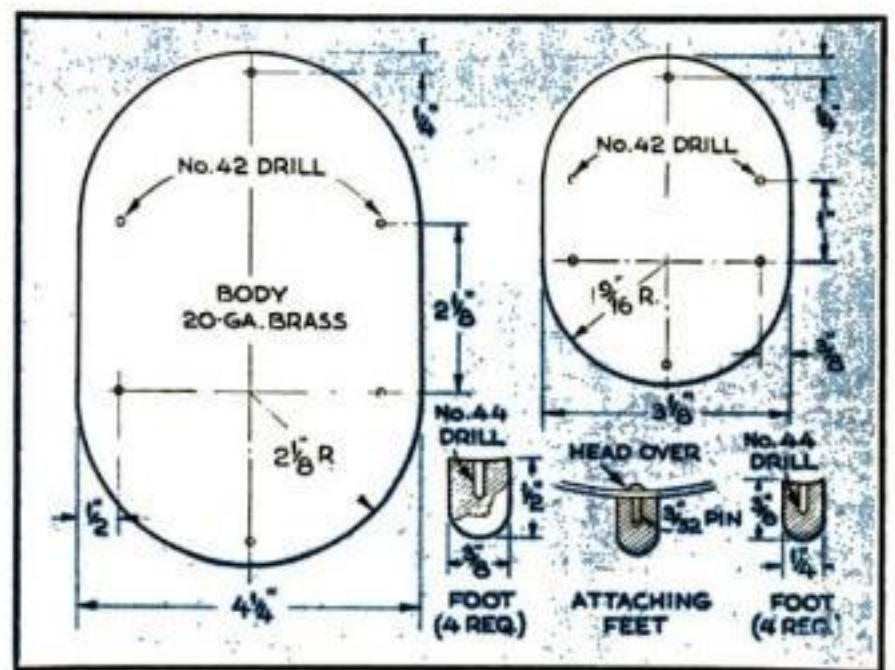
Construction is begun by laying out the ovals on sheet brass, 20-gauge or heavier. After cutting with a pair of snips, place the pieces on a smooth metal plate, such as the bottom of a flatiron, and tap with a mallet to flatten. Centerpunch and drill the six No. 42 holes, file off burrs, and round the edges slightly. Remove any scratches with fine emery paper and buff to a high luster.

Use a length of $2\frac{1}{2}$ "-diameter bar stock or pipe to form the baskets. The smaller is curved around the form completely, but the larger has just the sides turned up. Holding the pieces over the round stock, tap them with a mallet to smooth up the turns and to work-harden the brass.

Feet for the big basket are $\frac{1}{2}$ " lengths of $\frac{3}{8}$ " brass rod, and those for the smaller are $\frac{1}{4}$ " round stock. Drill a No. 44 hole $\frac{1}{4}$ " deep in one end of each piece, round the opposite end with a file while the work is re-

volving in a lathe or drill press, and relieve the other end with a half-round file to fit the contour of the basket.

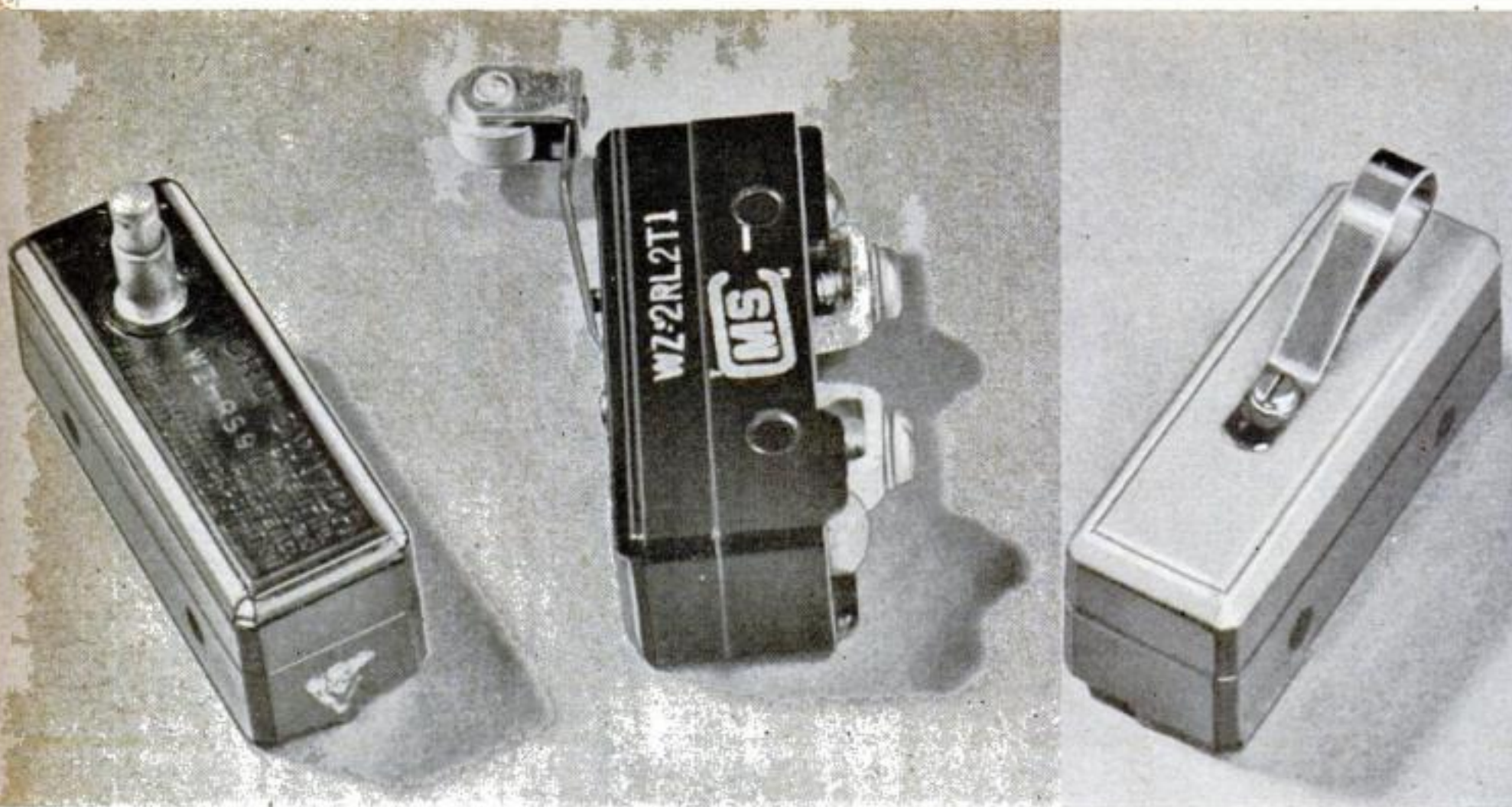
Cut $5/16$ " lengths of $3/32$ " wire, slightly taper one end, and drive into the feet. Then push the pins through the holes in the baskets and upset the heads with a ball-peen hammer while resting the foot on a metal block. The handles are made of $5\frac{1}{4}$ " and $9\frac{1}{4}$ " lengths of $3/32$ " wire or brazing rod.—*Bill Luther, Los Angeles.*



Flatten the ovals with a soft mallet. After polishing, form them around a $2\frac{1}{2}$ "-diameter pipe or bar stock, again using the mallet as below.

Head over the pins that hold the feet with a ball-peen hammer, resting the feet on a metal block. Form the handles over a length of pipe.





Various actuating devices (here a button, roller, and leaf) come on similar basic switches.

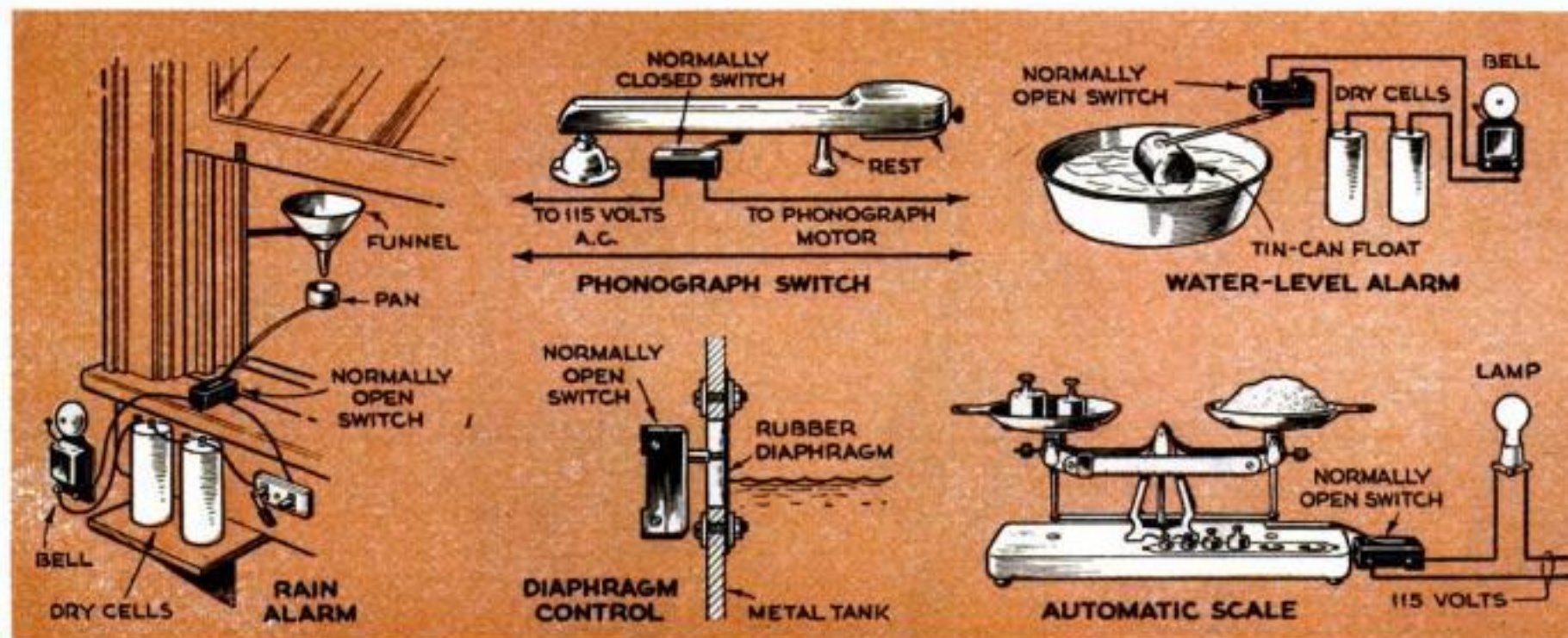
Midget Switches with a Hair Trigger

Say good-by to knife switches and get acquainted with these versatile and precise electrical handy men.

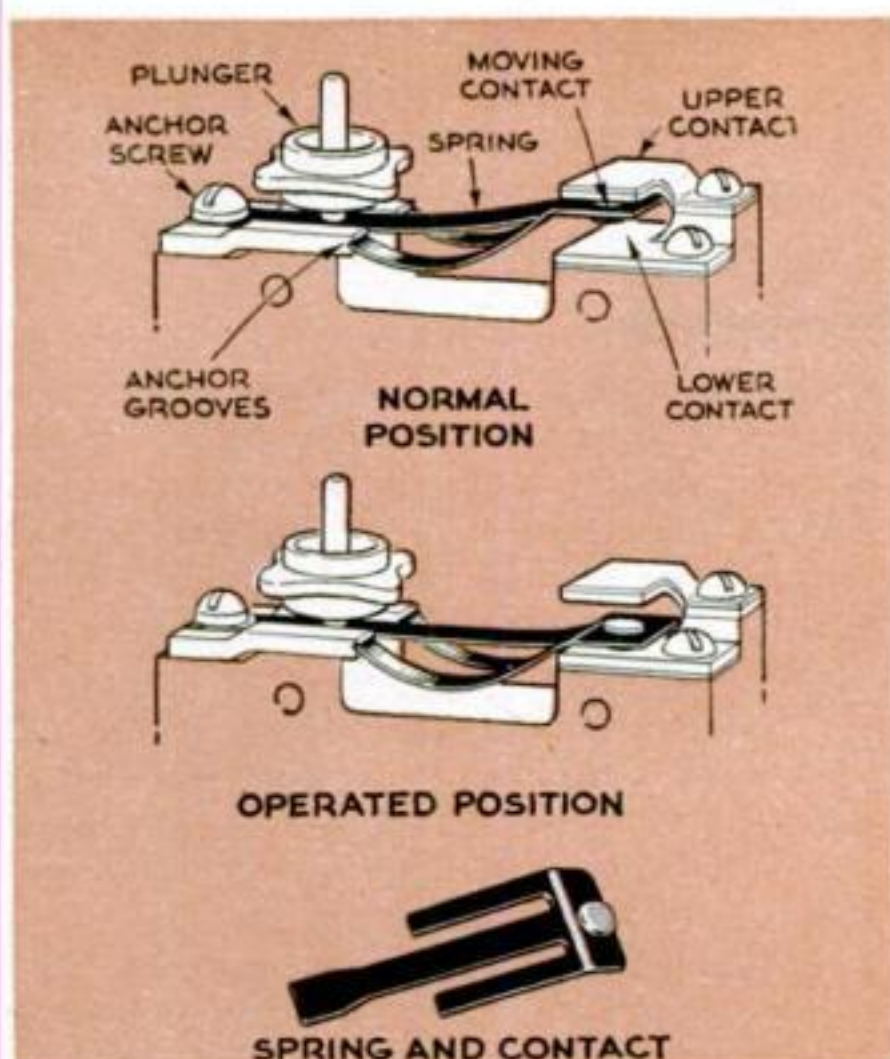


YOU CAN put one of these midget switches in your watch pocket, or hold a couple in your closed hand. Yet at 115 volts, one of them will easily handle 10

amp.—ample to run a ½-hp. shop motor. What's more, it'll do it with an operating pressure of a few ounces, and with a plunger travel of less than .005". Better yet, it'll



Countless applications in the home and shop will be found for these switches. Here are a few.

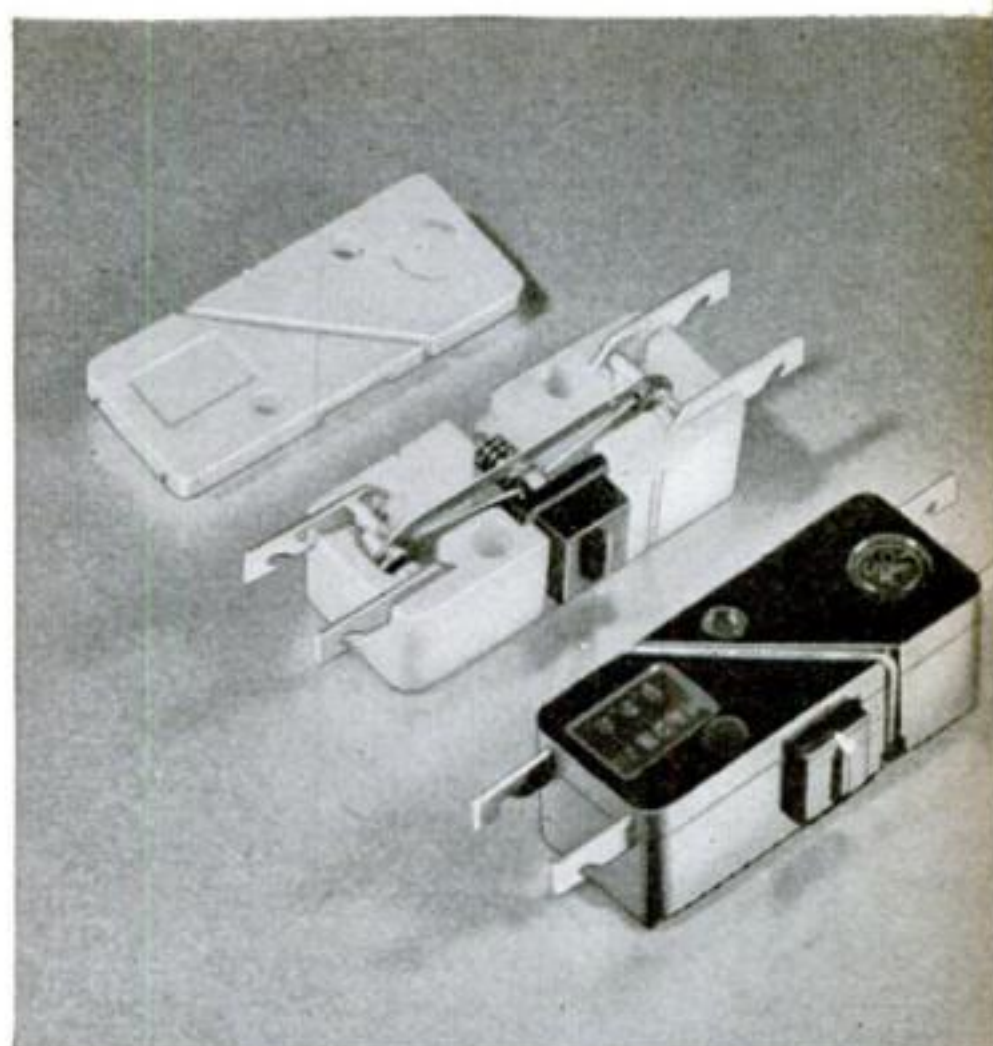


How it works is shown in this Micro Switch[®] phantom view. At rest the bowed spring arms hold the moving contact against the upper one; depressing the plunger snaps the spring down.

do its job in a matter of a few milliseconds, and will repeat the same task precisely and reliably for upwards of 1,500,000 times.

What this means for the workshopper (or the householder with a yen to put more electrical servants to work for him) is considerable. Up until recently, having chiefly knife and toggle switches at his disposal, he has been handicapped by their mechanical limitations and by the often laborious job of installation. With snap switches, the sky (and his own ingenuity) are the limit.

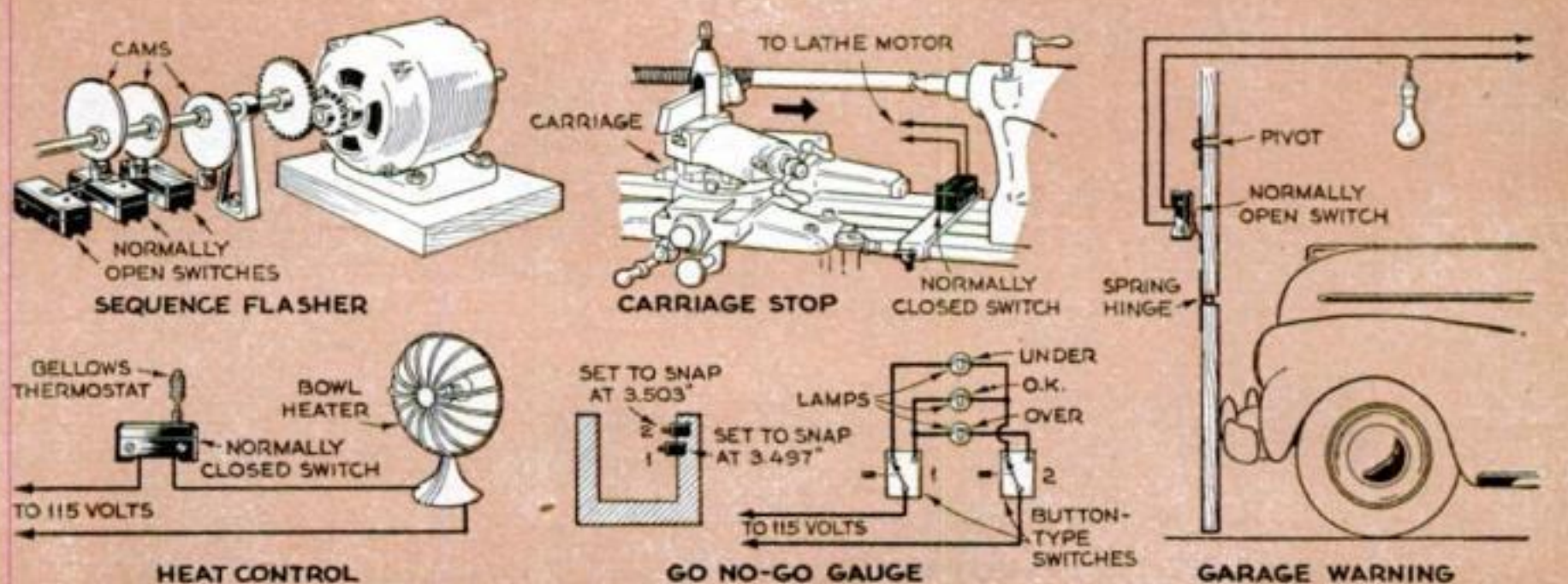
Though small enclosed switches of this



Lighter and smaller, this GE Switchette[®] is designed for light-duty service. The upper one has its cover off to show spring action. It can be either normally open or normally closed.

type began to appear in industry about 15 years ago, it wasn't until shortly before the war that they became common. With great volumes of them now available in war-surplus stores, and with new ones obtainable at electrical and radio-parts stores as well as mail-order houses, the craftsman who wishes to use them in his home or shop can choose from a variety of makes and styles.

While the operating details vary from make to make, such switches generally employ a curved arm of copper that's alloyed



Sensitivity, shortness of travel, fast action, and repeat accuracy are switch characteristics.

with beryllium for springiness and resistance to fatigue. This arm, carrying movable contacts at its free end or ends, is mounted in a plastic case in such a way that short movement of a plunger will cause the contact arm to snap down to a second position. The instant pressure is released, the arm snaps back. Both make and break are clean and sharp; there's no in-between position.

Most snap switches are of three types: normally open, normally closed, or single-pole double-throw. The "normally" designation describes the switch when no pressure is applied to its actuator—not necessarily the position in which the switch is usually left. To clear up the point, consider for a moment the switch controlling the light inside a refrigerator, which is a normally closed type, being held open when the door is shut. Note that in this application as in some others, a normally closed switch is habitually held in an open position.

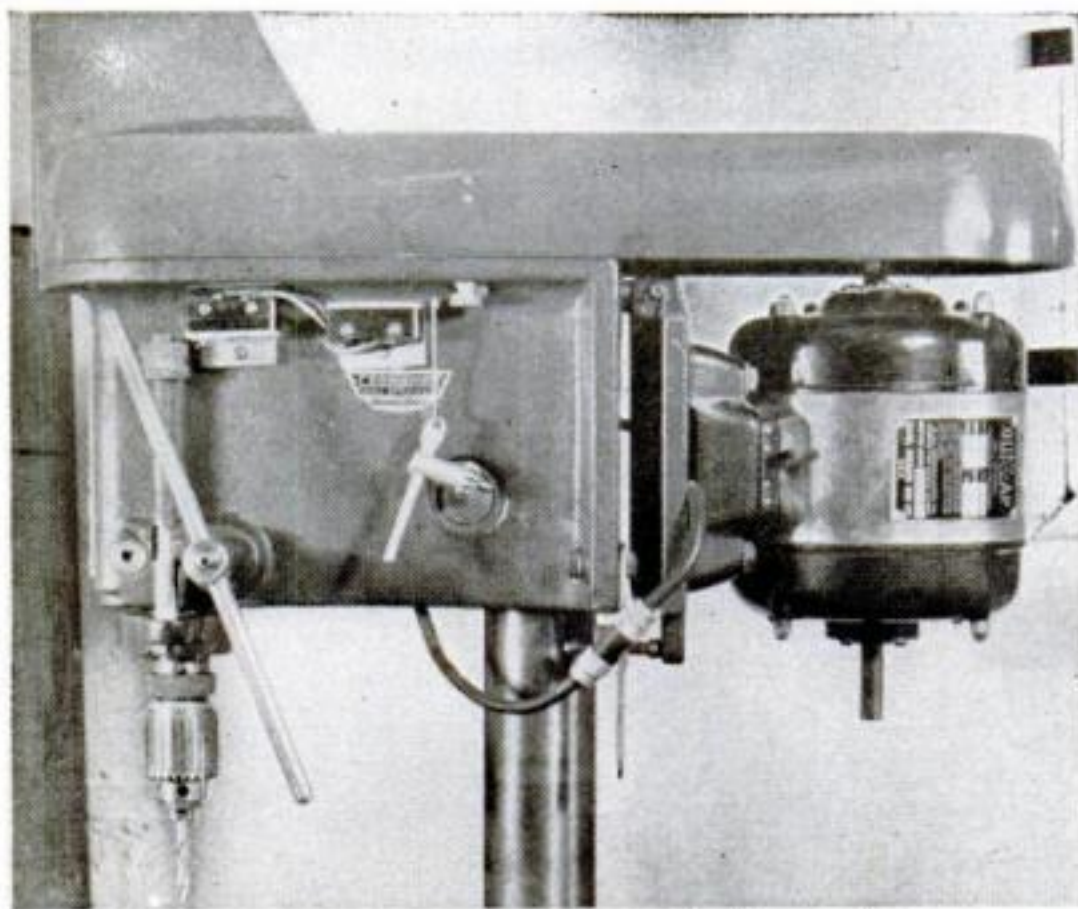
If you aren't sure of the uses to which you are going to put the switches, it's smart to get the SPDT type. This is because they can be used as either normally open or normally closed ones, depending on which

of the terminals you connect. One kind, shown at top right on page 193, can be connected to open and close two entirely separate circuits, or (with the lugs at one end connected together) employed as a SPDT switch.

Actuating levers to press the plunger on the switch are made in a variety of styles, including simple and compound levers, springy leaves, and cam-following rollers. Since forcible overtravel of the plunger may damage the switch, be sure to use a lever that'll protect the switch in cases where the applied pressure may be large. Suppose you use a normally closed switch on the bed of a screw-cutting lathe, wiring it in series with the motor so that it will cut power at the end of the carriage travel. The momentum of the motor, jackshaft, and gears may be enough, however, to move the carriage a substantial fraction of an inch *after* the juice has been cut. Your remedy, naturally, is to use a switch having either a telescoping button over the plunger or a springy leaf.

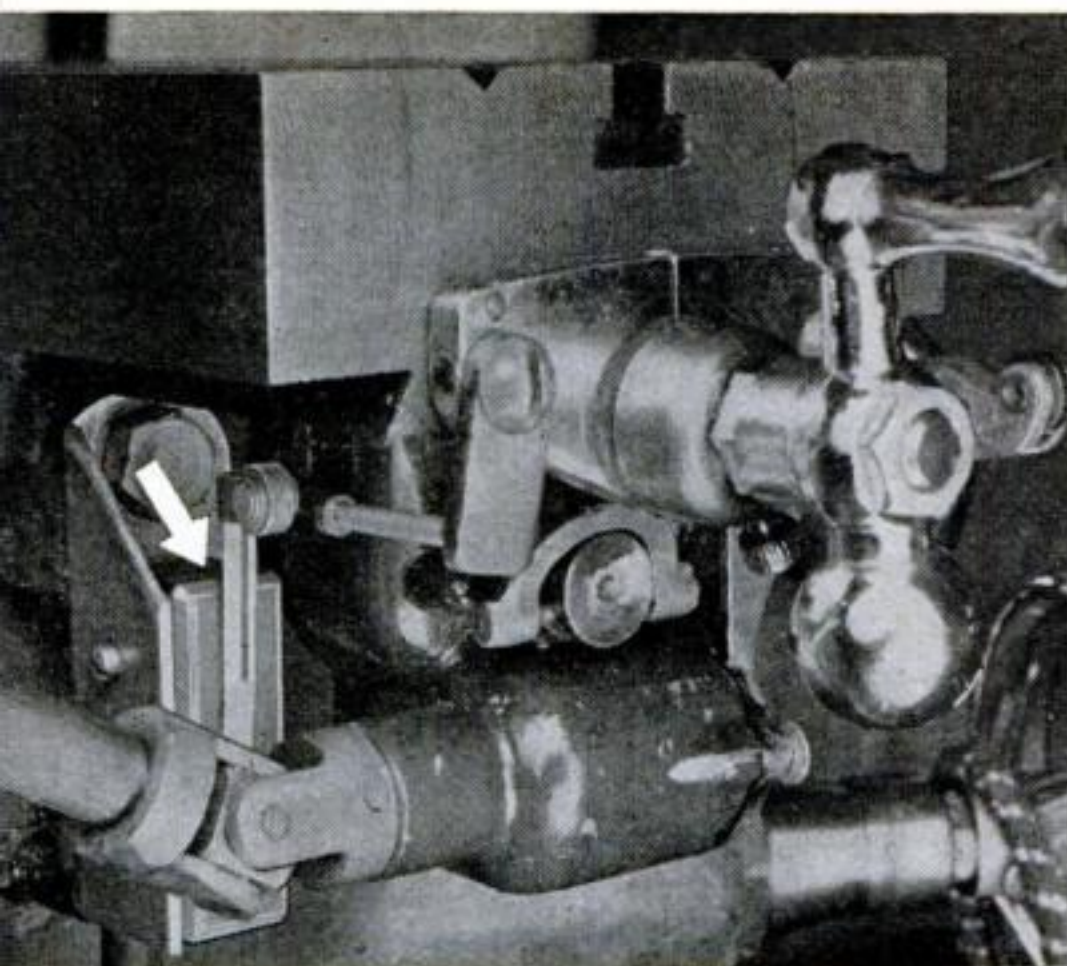
Just a few of the ways these handy gadgets can be used are illustrated on these pages. Almost all of the applications can be adapted to suit your needs. For instance, the water-level alarm would serve as shown as a reminder to dump the pan beneath the icebox, or to shut off the windmill or pump filling a tank. If the switch were changed to a normally closed type, the setup could serve as a warning that the stock watering trough or cistern was running low.

If occasion warrants it, a good deal of elaboration of these ideas is also possible. The automatic scale, for example, is handy for measuring a large number of identical quantities, and it signals when the specified weight has been poured on the scale. (Be sure to include the switch-tripping pressure in setting it to produce a particular amount.) As



For convenience and safety, H. L. Phillips, of Watertown, Mass., rigged a drill press this way. Moving the feed lever starts the motor—but only if the chuck key is hung up.





Damage to power tools having automatic feeds is made less likely with these switches. Here a normally closed switch is used on a bench mill to cut power at the end of table travel.

shown, the rig signals when a specified amount *or more* has been added; but it wouldn't be difficult to add a second switch and signal to show when the weight went above a second, upper limit.

The extreme precision and repeat reliability of snap switches were used in some war plants to make the electrical gauges shown schematically on page 193. A pair of switches checked each dimension, and several different dimensions were tested simultaneously. With an actuating movement of little more than .001", the gauges were accurate enough for many jobs.

One agreeable thing about the switches is that they're tailormade for duties that you want performed automatically. Consider for example the drill-press application shown here. If you've ever inadvertently left the chuck key in the chuck when the motor was switched on, you know that it can be slung out with dismaying violence. In this setup that *can't* happen; the motor just won't start until the key is hung up where it belongs. The other switch is more of a convenience than a safety measure, but starting the motor just by pulling down the feed lever will be appreciated by anyone who has groped for an awkwardly placed drill-press switch.

Many applications of snap switches will be suggested by your own activities. Thus the radio ham will use them on transmitter-

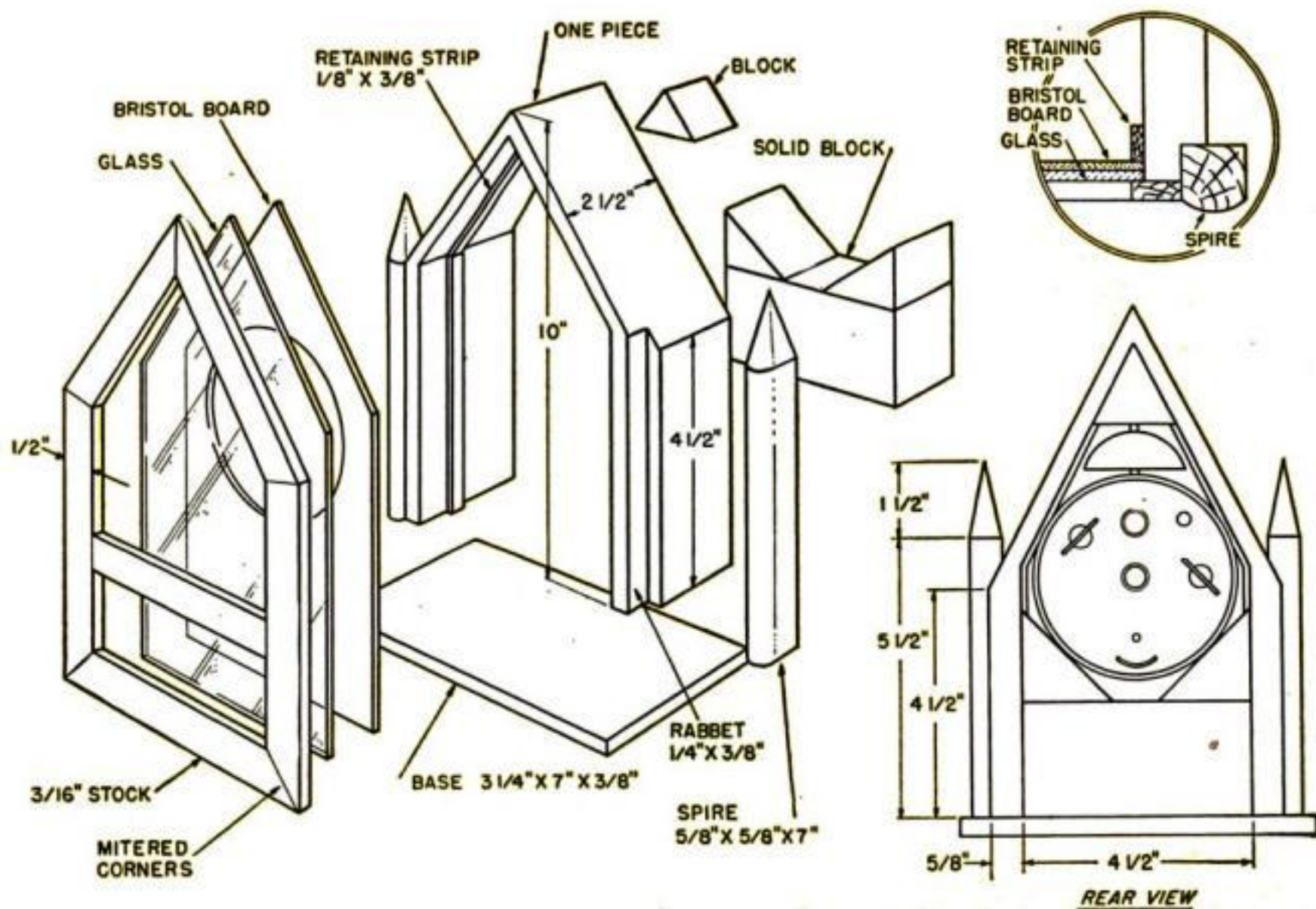
cabinet doors to cut the primary of high-voltage transformers when the cabinet is opened. Or the truck operator will put them under the springs to signal overloads or on side or rear gates to tell if they aren't shut.

The photographer will find them particularly handy. With a few scraps of wood and a hinge, a snap switch becomes a foot switch that will make enlarging easier. A light in a hall outside the darkroom door won't fog valuable film, no matter who walks in inopportunistly, if it's fed through a switch held shut by the darkroom door. A normally open switch attached to the paper storage box and connected to the white room light will protect photo paper.

For the householder, they'll come in handy for an automatic closet light, using a normally closed type. Or for burglar-alarm systems, using normally closed switches that are held open by acceptable window or door positions, or by taut trip threads. Or for gate or mailbox signal devices. Or for home fire-alarm systems (normally closed switches held open by bits of low-melting-point wax might do the trick). Or for position indicators if you have to get a big car in a small garage. END



A push-to-talk control for an inexpensive microphone can be easily installed. Since it requires only very slight pressure, it can be kept shut for a long time without discomfort.



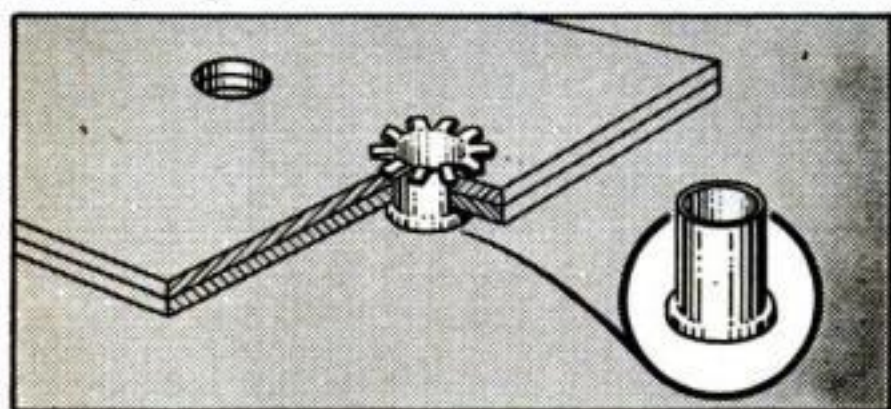
New Case Covers Old Clock

ENCASED in a cathedral-type housing like this, an ordinary alarm clock becomes an attractive mantel timepiece. Although the original is light maple with a natural finish, walnut, mahogany, birch, or cherry would be just as pleasing.

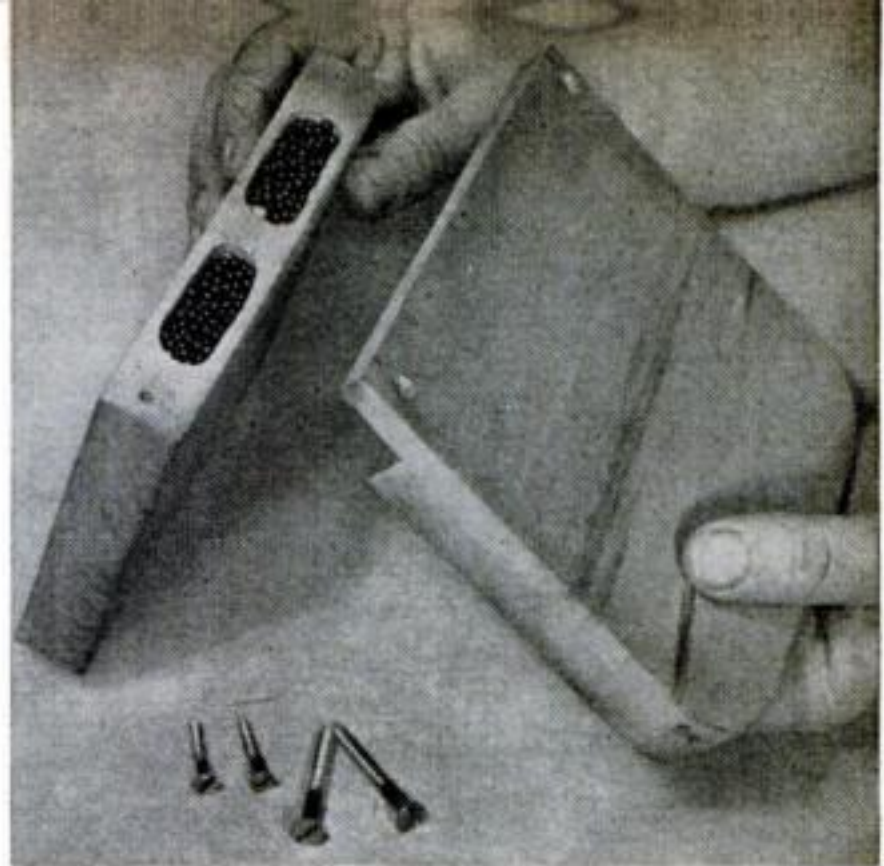
The main part is cut from a solid block, the outside being sawed to shape first and the corners rabbeted for the spires. Then with a jigsaw cut out the inside, making the walls $3/8"$ thick and the roof about $3/4"$. The frame for the face has mitered corners and is glued to the housing after the bottom is installed. Cut glass to a loose fit, put it in from the back, and secure with retaining strips. Also cut a Bristol-board mask, making the opening slightly smaller than the clock diameter. Decorate it with ink. The clock itself rests on blocks. Leave the back of the case open for winding up the clock.—Hi Sibley, Nuevo, Calif.



Empty Rifle Shells Rivet Sheet Metal or Wood



I USE empty .22 cal. shells with great success as hollow rivets to join sheet metal or light wood. The hole in the work must of course be a snug fit since the rim on the shell isn't much larger than the case. In joining thick pieces, use long-rifle shells. Shells of larger caliber could likewise be used.—Walter Nelson, South Ozone Park, N. Y.



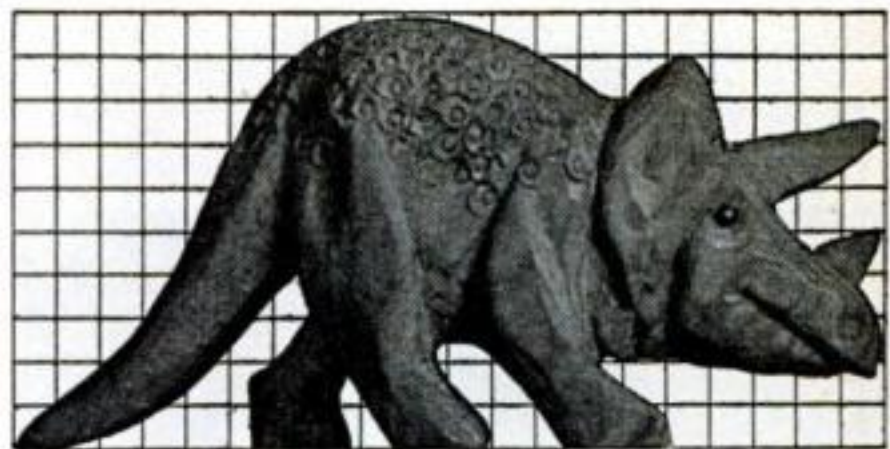
Carved Triceratops Adorn Bookends

BACK in the days of dinosaurs, you might have met a fearsome three-horned creature called a triceratops. Luckily for us, those huge animals are now extinct, but carved miniatures on a pair of bookends will bring them back in less alarming and more decorative form.

Lay out the profile on $\frac{3}{4}$ " squares and saw the figure from 2" stock. Redwood is good for this because it carves easily and shellac brings out its pleasing natural color. However, almost any free-carving wood will do.

In carving the figure, remember that it has three horns, two above and a third centered on the nose below. Roundheaded nails or escutcheon pins may be used as eyes. The scaly hide on the back is formed by pressing a leather punch into the wood with a turning motion, slightly overlapping the rings, and then tapping a small nailset into the center of each ring.

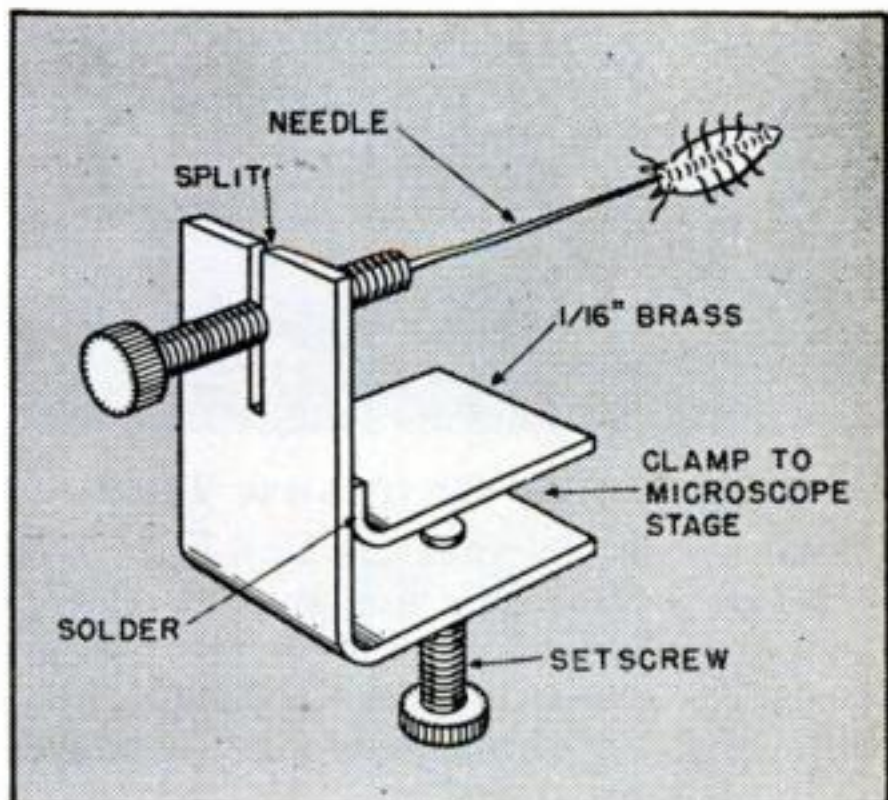
Cut the bookends from $\frac{3}{4}$ " stock, making the base $4\frac{1}{4}$ " by $5\frac{1}{2}$ " and the upright 5" by $5\frac{1}{2}$ ". In the lower edge of the upright, cut a $\frac{1}{2}$ " by $\frac{3}{4}$ " rabbet so it will overlap the back edge of the base and retain lead shot poured into two recesses in the base as weighting material. Cut the recesses by making a series of holes with a $\frac{1}{4}$ " drill and then cleaning out the intervening wood. Attach the carvings by putting glue on the feet and running screws in from below.—Elma Waltner, Hurley, S. D.

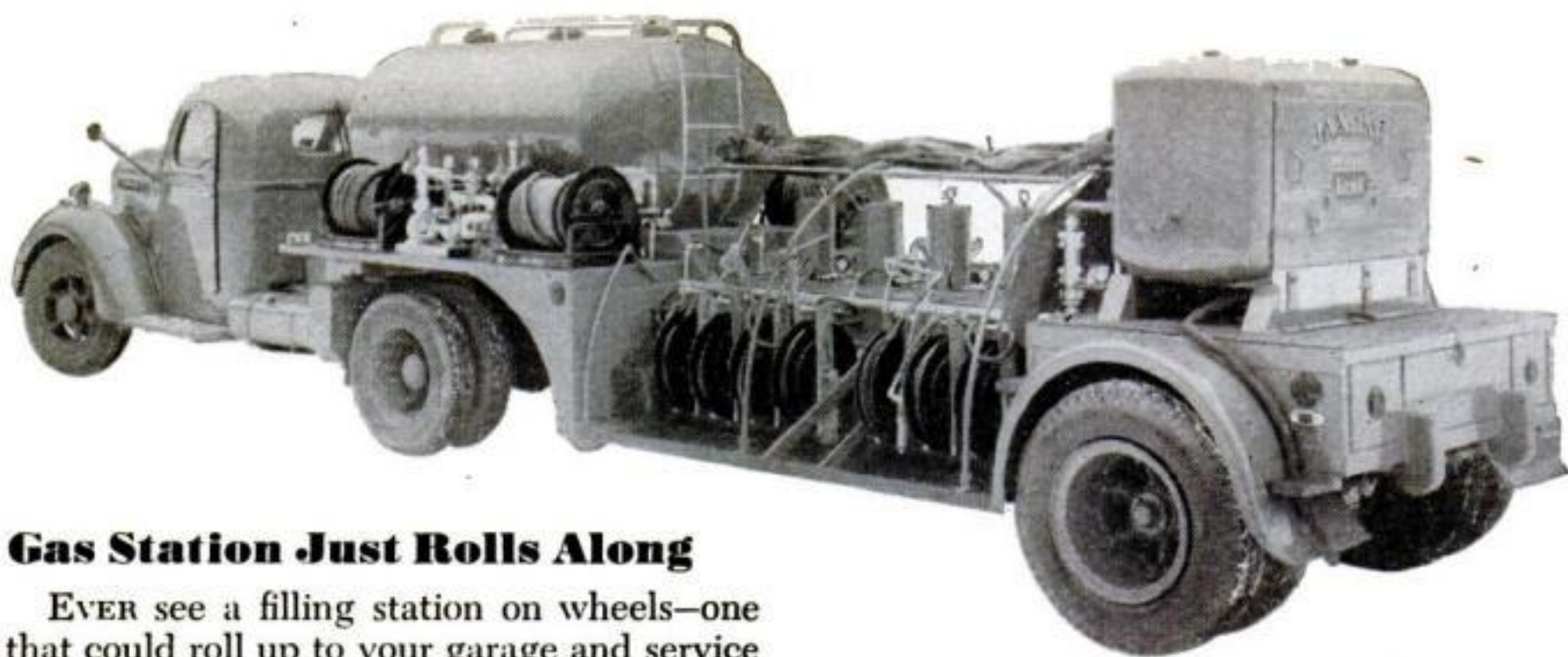


Insect Held Under Microscope

SMALL insects that are being examined under a low-power microscope usually are difficult to handle. This simple mechanism makes it easy to manipulate them.

Since microscopes vary in size, you must determine your own dimensions. Make the frame of brass at least $\frac{1}{16}$ " thick. Anything thinner will not provide enough threads. After drilling and tapping a hole in the vertical piece, split it with a jeweler's saw, and pinch the piece together in a vise. This will cause enough tension to keep the screw in any desired position. Solder a needle in a hole drilled in the screw.—Raymond F. Yates, Lockport, N. Y.





Gas Station Just Rolls Along

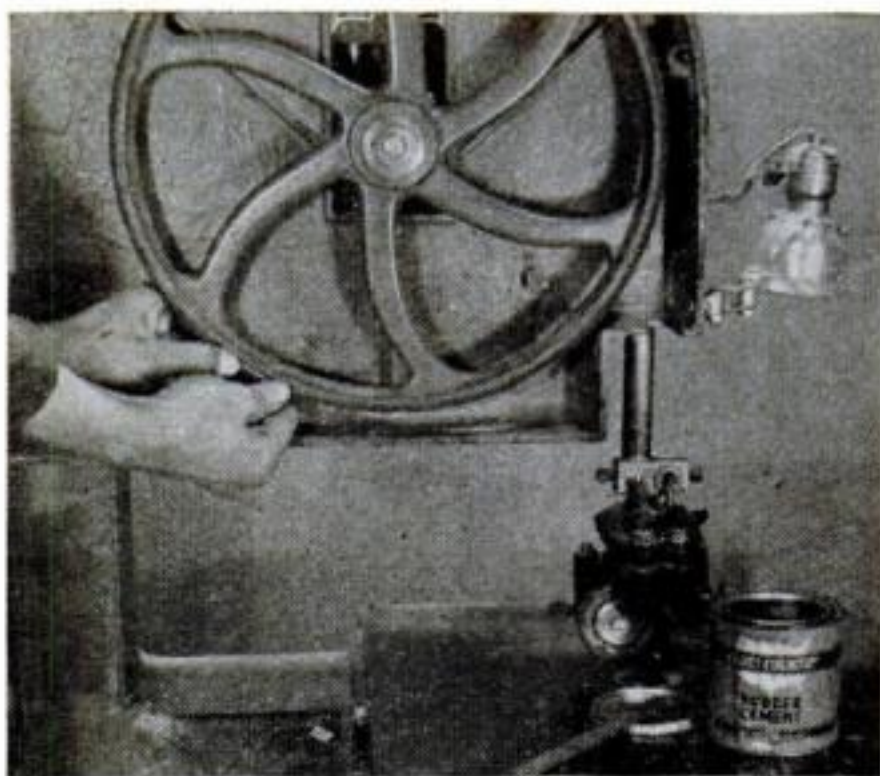
EVER see a filling station on wheels—one that could roll up to your garage and service your car with gasoline, oil, water, and air? Well, take a look above.

Although this 21' machine could do all these things for your personal benefit, it's designed primarily for servicing heavy construction machinery and airplanes. It may also serve as a means of pretesting sites for permanent service stations.

Manufactured by Jax, Inc., of Pittsburgh, the mobile unit carries 700 gal. of gasoline and Diesel fuel, 200 gal. of various oils and greases, 60 gal. of water or antifreeze, quantities of kerosene, and compressed air for tires and other uses. It may be hauled by any tractor truck and is quickly coupled or uncoupled.

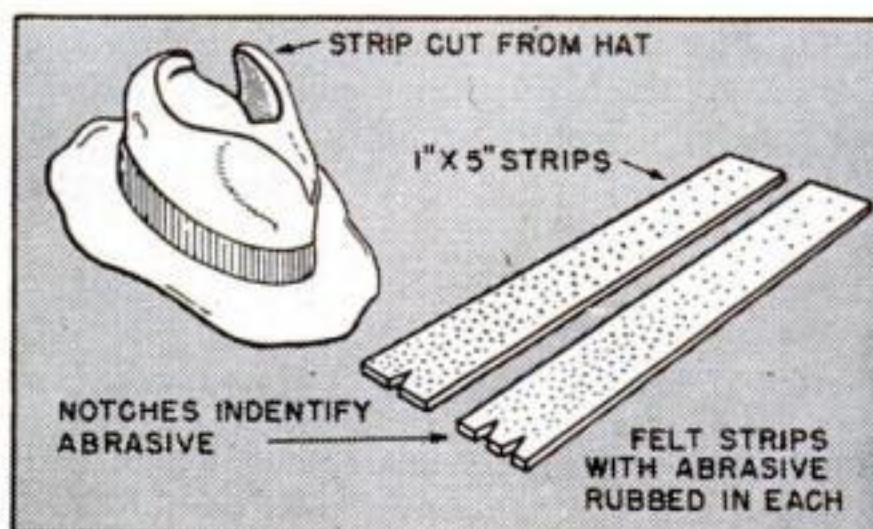
Bands Form Grip for Shaver

SEVERAL wide rubber bands slipped over the barrel of an electric shaver will give you a better grip on it. The bands also act as a cushion and prevent the shaver from moving around when it is put down on a hard, flat surface.—*R. Hanscom, Elmhurst, Ill.*



Cement Holds Bandsaw Tires

WHEN bandsaw tires are replaced or if they loosen after long use, rubber cement can be applied to keep them securely in place. The cement does not become brittle with age and it permits easy removal of the tire if this is ever necessary.



Polishing Strips Cut from Hat

A FEW strips cut from a felt hat that has outlived its usefulness are very handy for polishing work revolved in a lathe or drill press. I find them most convenient if cut about 1" wide and 5" long. Rub a different grade of grinding or polishing compound into the various strips and mark them for identification by cutting notches in the end. Store a supply of them in a drawer near the lathe or drill press and they'll be quickly available.—*Ivan Baxter, Hartland, Wis.*

What's Your Ingenuity Quotient?



The sweeps winnings in our shop are bolts, nuts, nails, and the like salvaged from shavings and other floor litter. The stuff wouldn't be worth separating by hand, but it's easy to sweep up everything and dump it in a bucket of water. When the water is poured out, shavings and dirt go with it but metal remains. Better than a magnet, this gets brass, aluminum, and copper as well as iron and steel.—*John Krill, No. Lima, Ohio.*



Here's how we kept a card game going even after a power-line failure made our living room blacker than the ace of spades. So that we could tell a deuce from a king, we improvised half a dozen "candles" from whiskey jiggers, cardboard, cooking oil, and string. Any kitchen oil will do.—*Thomas Spall-Etta, Bellerose, N. Y.*



It's a shocking business to polish cars because the fast-spinning buffer builds up a static charge on the metal body. The busy electrons are so anxious to get home that they'll use you as a path to ground unless you give 'em a better one. How? By standing an iron bar against the bumper as shown so that the charge can leak off as rapidly as the polisher puts it on.—*Russell L. Card, Tweed, Ont., Canada.*



A little reflection solved the problem of keeping tabs on our frozen-food cabinet. Being too large for the kitchen or basement, the freezer was put out in the garage. But the signal light that goes out when the temperature rises to the danger point must be visible at all times. An auto rear-view mirror does the trick. Properly placed, it deflects the rays into the house. The light is so accurately focused that it can't be seen from the street but is visible indoors day or night.—*Fay O. Wood, Elkhart, Ind.*

Have you pulled off a smart one lately? We will pay for acceptable contributions showing ingenious solutions of problems in the home, shop, garage, or camp. It doesn't matter if it's wacky—if it works.

How Cape Codders Build the Flat-Bottom Skiff



The salt-water men who know how to handle these sturdy boats can also show you the right way to build them.

By Elon Jessup

MANY people build small boats, both along the sea coasts and inland waterways. Some are good—and some not. On Cape Cod, the elbow-shaped strip of Massachusetts that juts out into the Atlantic, small boats are a part of our everyday lives, and those of us who live there believe the ones we build usually stack up with the best.

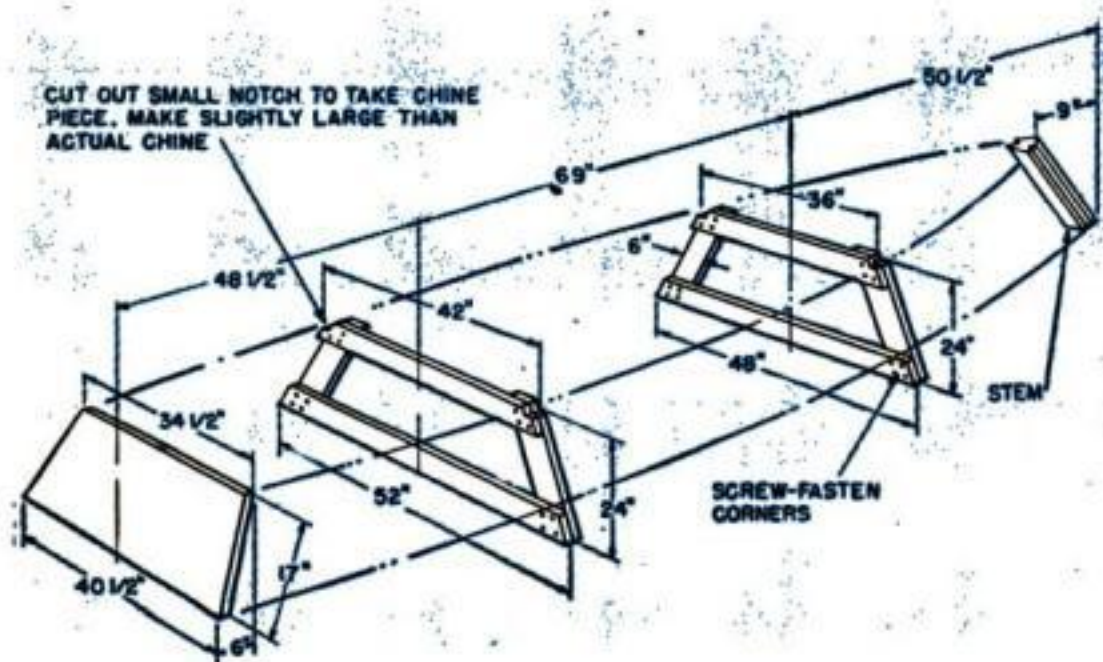
Take this flat-bottom skiff. A pretty ordinary looking affair, you may say. Sure. But it got that way because every part of its design has been tested, over and over again. Measuring 14', it's sturdy without being heavy. The cedar sides are $\frac{1}{2}$ " thick; 13 frames cut from $\frac{3}{8}$ " by $1\frac{1}{2}$ " oak and spaced along each side give it additional strength. It's a good small boat, anyway you look at it and wherever you want to use it.

Two temporary wood molds are required. Each consists of uprights and crosspieces cut from rough stock about 6" wide. It's around these that you build your boat and, once made, they may be used for as many boats as you wish.

If you're working from a set of plans, dimensions of the molds will be given. But suppose you want to duplicate a skiff you've seen along the waterfront. In that case, just take along your stock and build the molds directly against the inside of the bottom and sides of the actual boat. Also make transom measurements of the boat you are copying. Mold and transom measurements suitable for this particular skiff are given in the drawing below. Note that notches are cut in two corners of each mold so that they'll clear

the chines. The stem requires a careful bit of work. Saw it first to the cross section of a triangle with a 4" dimension on each side. Then cut a $\frac{3}{8}$ " by $1\frac{1}{2}$ " rabbet at two opposite corners. These take the side planks. Make the stem a bit longer than the finished length so you can butt the first bottom plank against it.

With the forms, transom, and stem in hand, you're ready to start construction. But first a firm building platform should



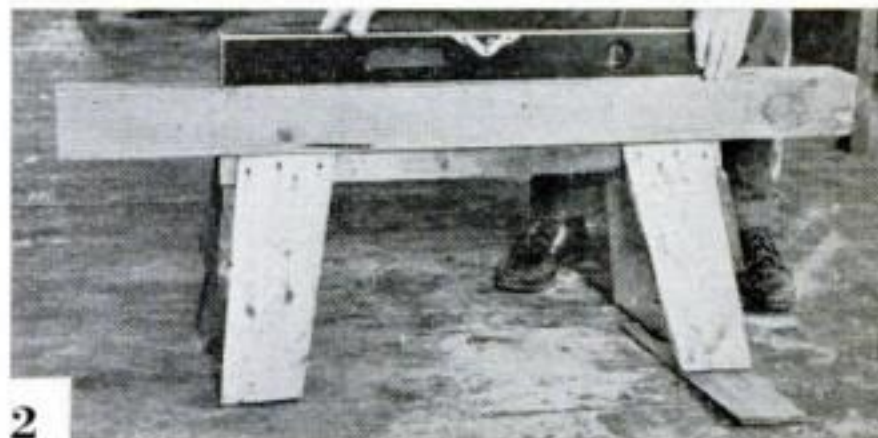
be assembled. A pair of low sawhorses with three long planks across them will do nicely.

From here on, the photos tell most of the story. There are several helpful points not mentioned, however. Ordinary 1½" galvanized wood screws were used to fasten the side planks to the transom and stem, and the same for the frames. Hold the head of the stem firmly in place with small blocks nailed to the platform. Also nail two or three battens to the other end, attaching these to an overhead beam or similar bracing. Before installing the side planking, plane the touching edges to a perfect joint. Long boat clamps are best for pulling the sides against the transom. If you don't have these, you could tie a heavy rope around the sides, winding a metal rod through a loop in the rope. The chines are simply butted against the cleats screwed inside the transom. For best appearance, taper frames to about ½".

A small skiff you happen to like may be duplicated by building a pair of molds against the inside of its sides and bottom. Measure the distance from the stem to the two molds so you can locate them in the same spot in your boat.

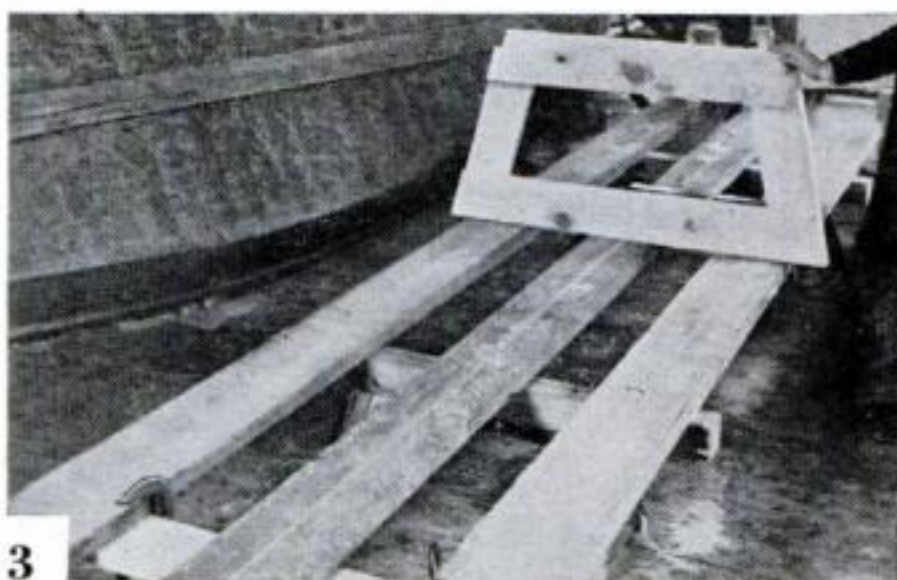


1



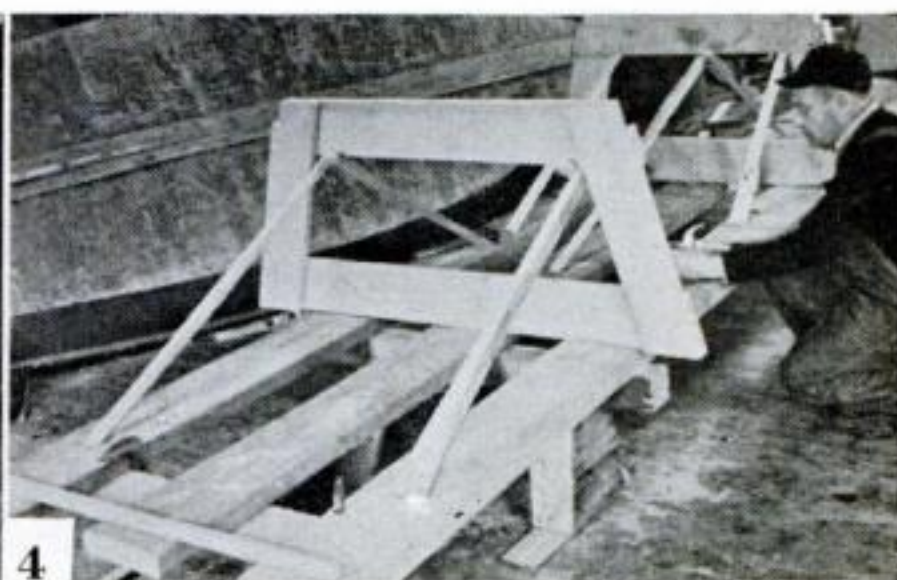
2

Level two sawhorses as a working base when molds and transom are finished. Shim the legs with shingles if necessary. After the horses are level, nail each leg to the shop floor.



3

Three heavy planks spiked to the sawhorses serve as your building platform. Snap a chalk line down the center of the middle plank as a center line. Then position the two molds.

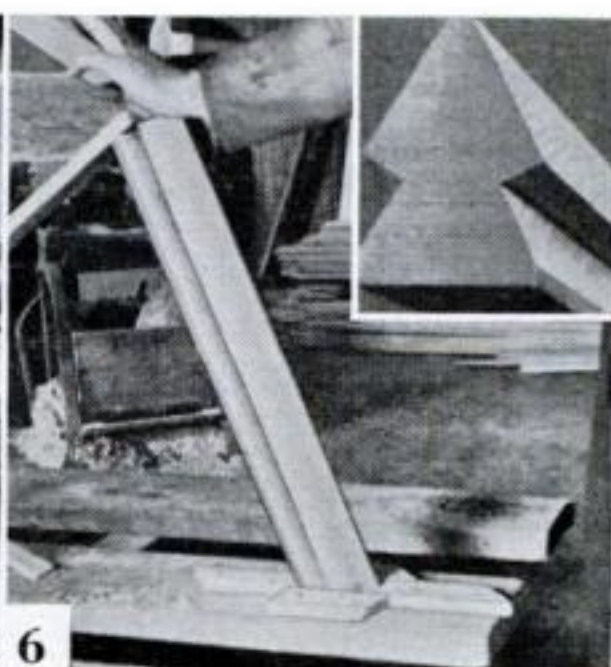


4

Brace and nail the two molds rigidly in place. For building convenience, it's a good idea to locate the molds so the end of the platform and the stern of the boat will coincide.



5



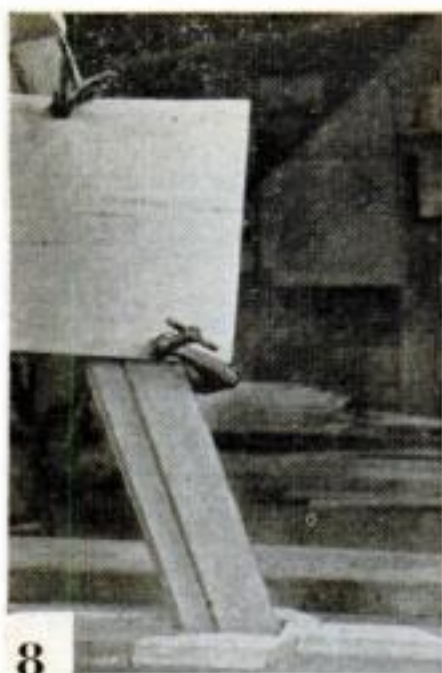
6

Nail on two uprights at this end as a means of bracing the transom when you're ready to put the latter in place later. Make the stem from a piece of oak, first cutting it to a triangular section and finally rabbeting two corners as seen in the inset photo above.



7

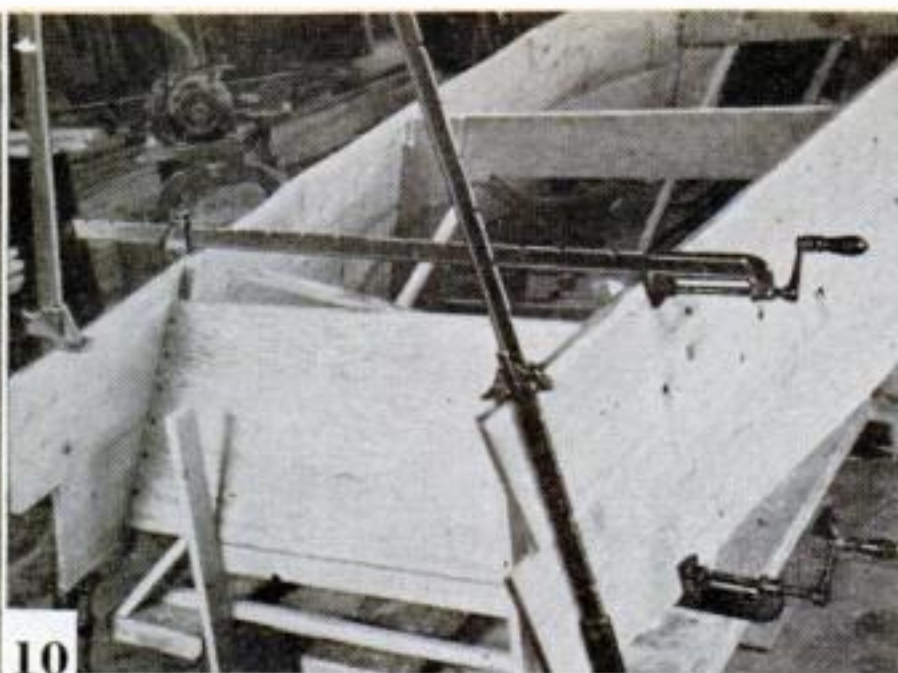
Set up the stem at the location you've already marked for it along the center line and tilt it to the desired angle. Bear in mind you are building the boat bottom up and that the top of the stem goes down. Brace the stem as in the two photos above. Note brace to the ceiling.



8



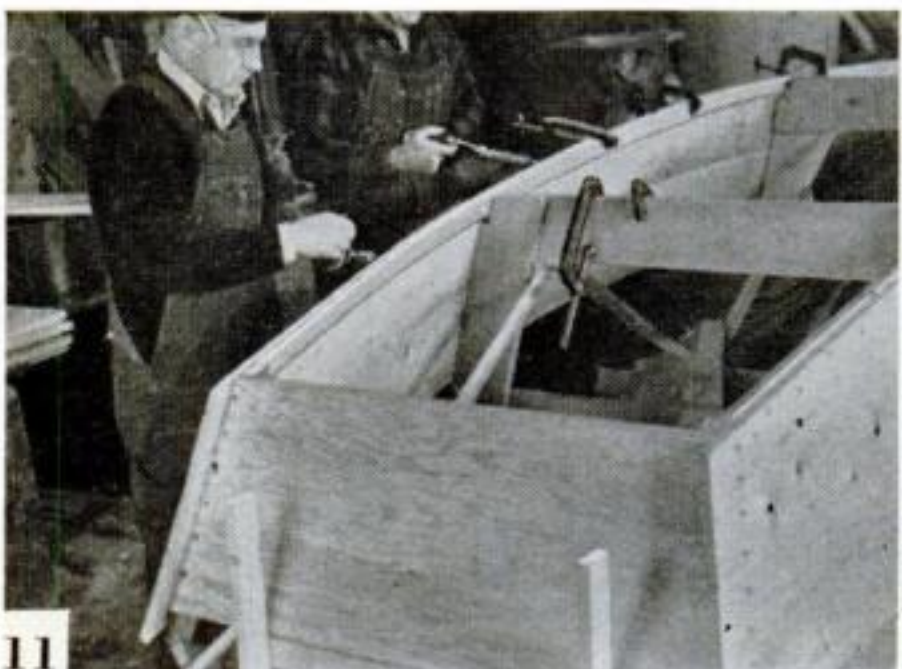
9



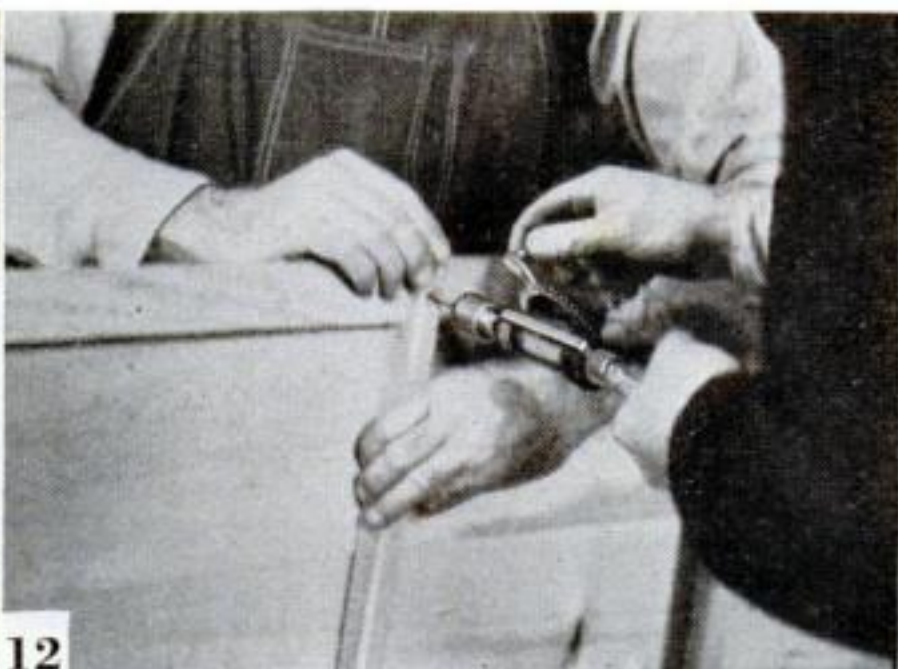
10

Mark and saw the sides to fit into the rabbet in the stem, drill half a dozen holes in each, and screw to the stem. Working aft, press each plank in succession against the molds and fasten in with screws. Later they'll be removed and the holes plugged. Now for the stern.

Draw up the planks against the transom with clamps, bracing the transom against the two uprights previously installed and tilting to the desired angle. Fasten the sides by running screws into 1" by 1" oak strips that you have screwed to the transom flush with each end.



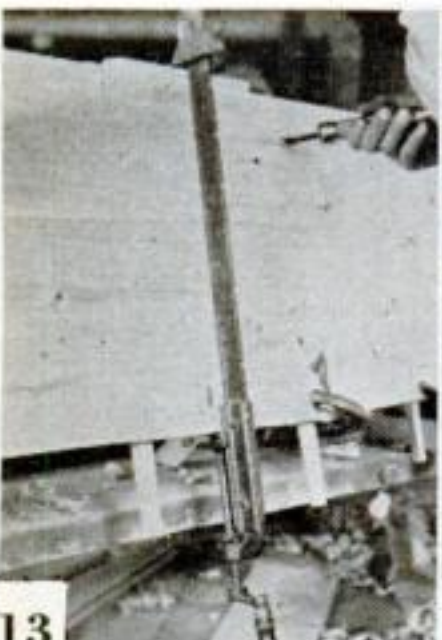
11



12

The chines are put in next—after the sides have been rigidly fastened at all points. These should be strips of $\frac{3}{4}$ " by $1\frac{1}{2}$ " oak long enough to run from stem to stern at the inner junction of the bottom and sides. Screw-fasten them, and plane down the bottom edges of the sides.

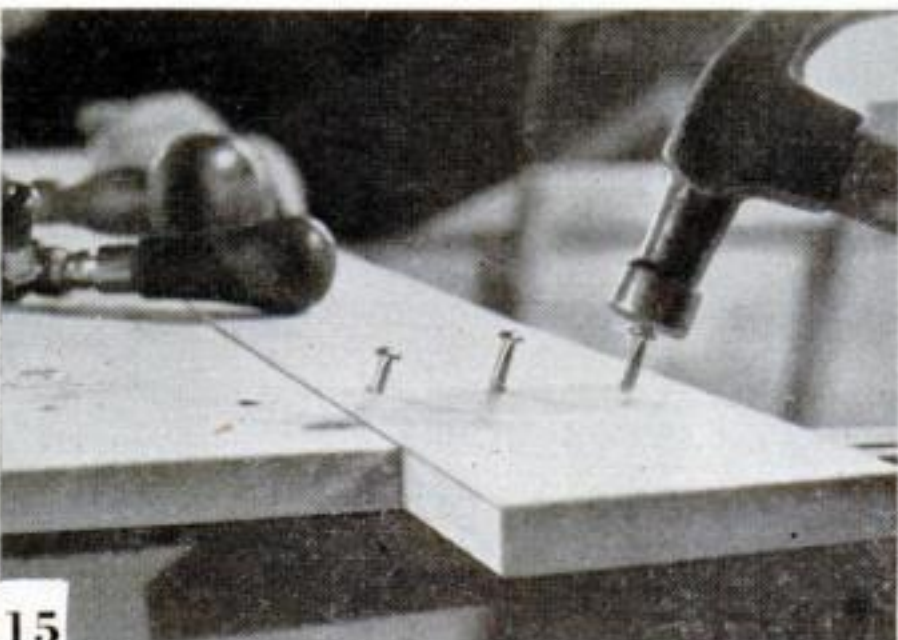
All of the frames are notched at one end so they will fit over the chine. Working from inside the boat, turn a screw through the notch area into the chine. Made from $\frac{3}{4}$ " by $1\frac{1}{2}$ " oak, the frame pieces at first are cut only roughly to length. Saw off the ends after installing.



13



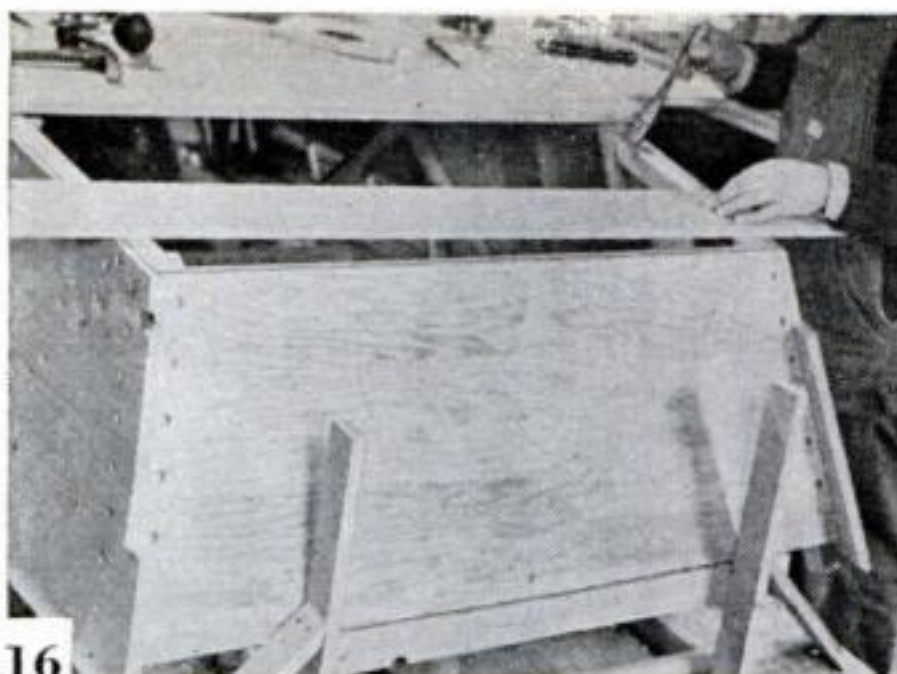
14



15

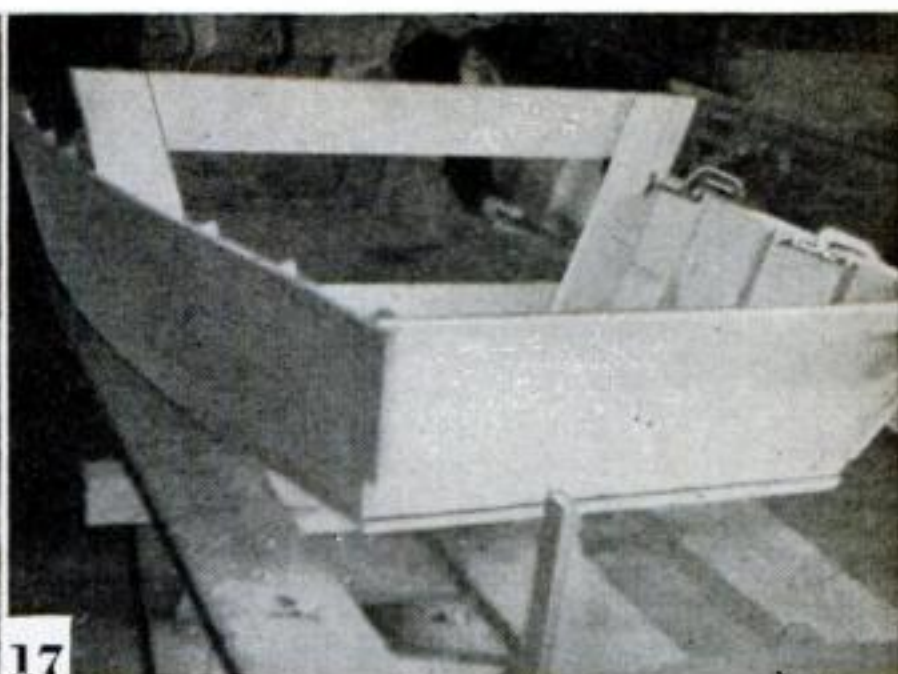
Compress the side planks together with long boat clamps and insert half a dozen screws in each frame piece from the outside to make the construction solid. Countersink all the screw heads. You're now ready to plank the bottom. Put the first piece against the stem as above.

Angle the nails in this way, forcing each plank snugly against the preceding one, as you apply the skiff bottom. Throughout the job, keep a can of paint at hand, as in the center photo above, and remember to coat any edge or area that will be hidden.



16

Work toward the transom, alternately applying paint and nailing a plank. Use galvanized boat nails for this and drill a hole for each into the oak chines. As you put down the last plank or two, you'll see whether the first one at the stem was placed square across the boat.

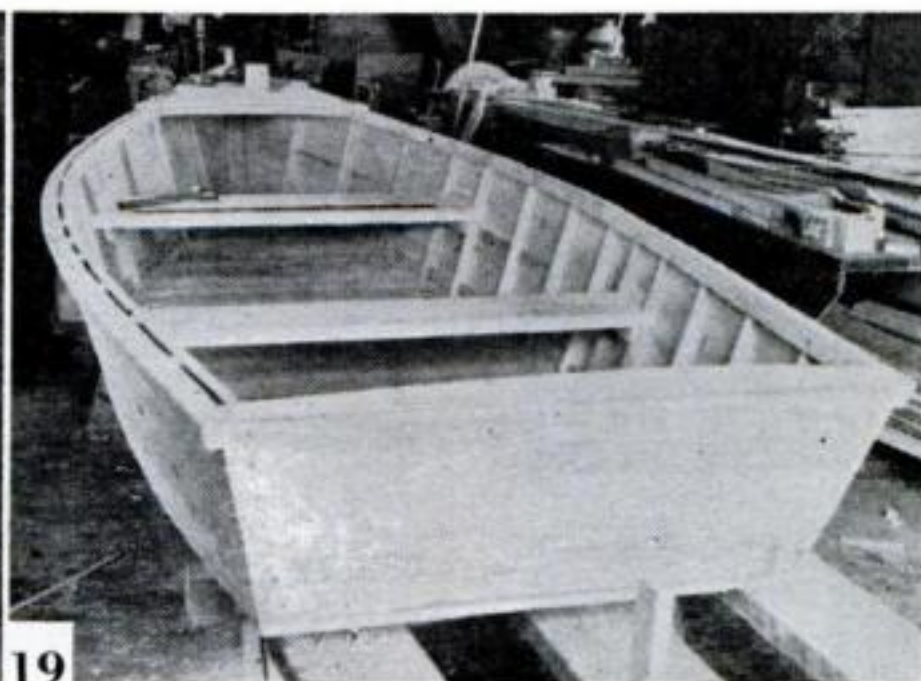


17

Now turn the boat right side up and remove the molds, for their job is now done—at least as far as this boat is concerned. Decide where you want seats, cut them to size, and install by means of cleats. A cleat straddling adjoining frames is usually the best method.



18



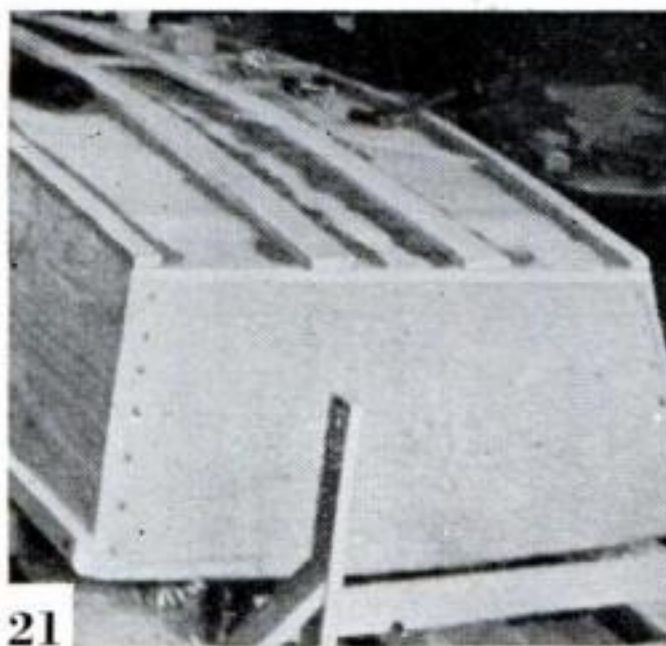
19

Saw off projecting pieces flush—and the boat will begin to assume finished form. Spring in an oak inwale from stem to stern on each side and screw to the frames, attach oak guard rails outside, and place a triangle of water-proof-plywood decking on the bow section.

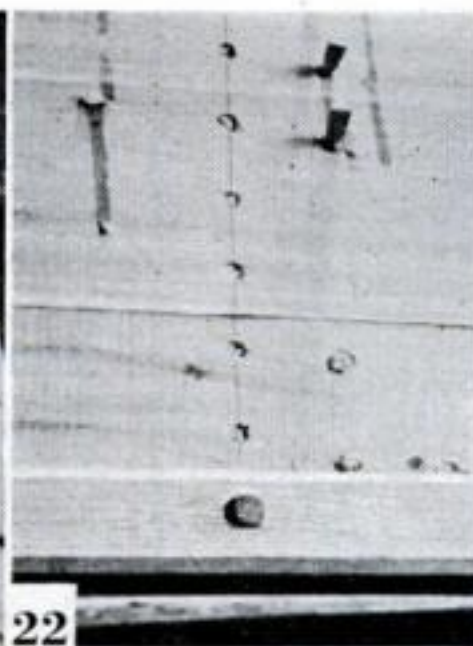


20

Again the boat is turned upside down, this time for calking the bottom seams. Use cotton wicking and work it in with a calking wheel. After the calking has been finished, cut and fasten oak rub planks to the bottom, first applying paint to all surfaces that will be hidden.



21



22



23

Four rub-planks will afford maximum protection to the bottom—two down the center and a narrow one along each edge. Now drill out any knots in the sides and fill all of these and the countersunk screw holes with wood plugs, dipped in marine glue and tapped home.

As the final step, go over the outside with a power sander, smoothing all the rough edges. Then apply several coats of paint, inside and out. When the paint is dry, install oar locks in the desired position, get a good pair of oars, and you're set to hit the water. END

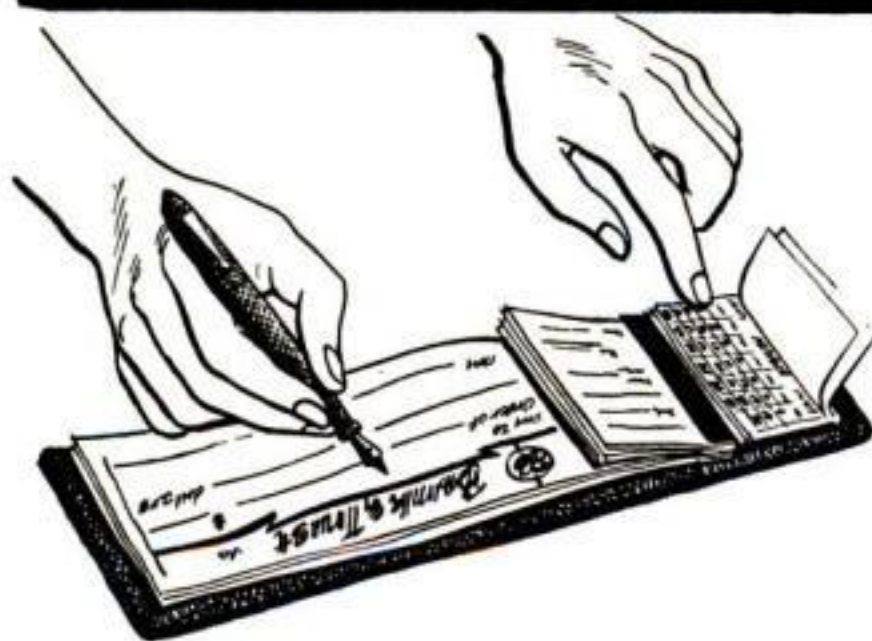
Keeping the Home Shipshape



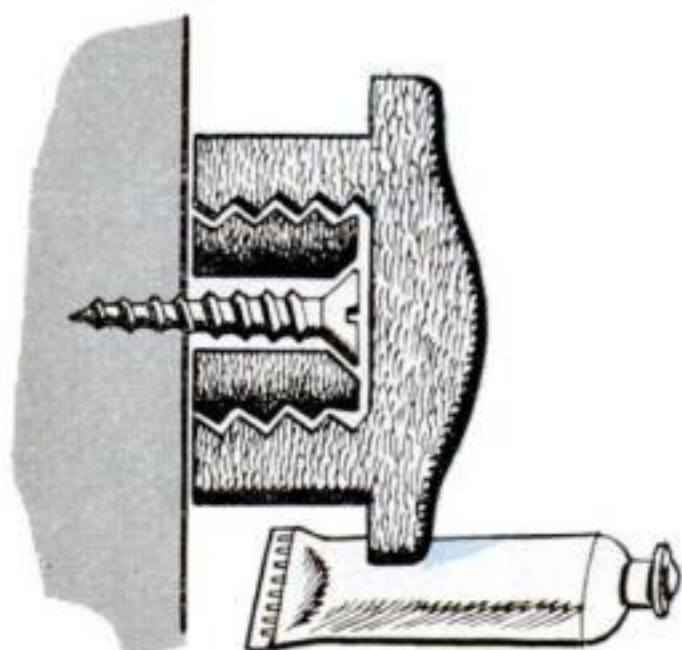
A lawn-mower stirrup bent from strap iron as shown, or one made from an old bicycle pedal, will enable you to kick as well as push the mower through clumps of tough or wet grass.



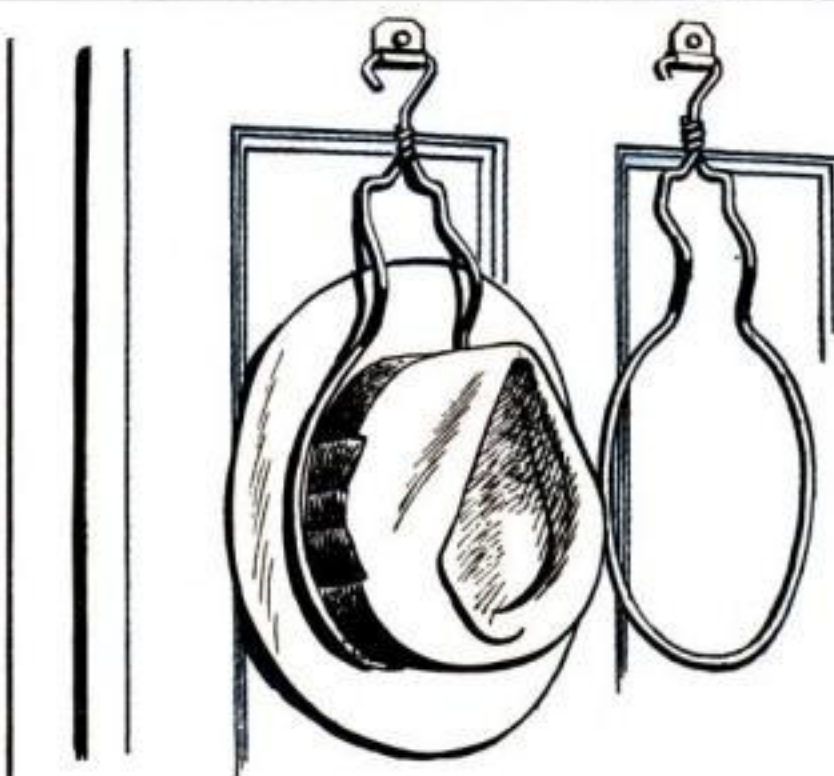
Nailing a piece of rubber belting to a wooden handle makes a good cleaning tool for gutters. The flexible belt follows the trough contours but can't scratch the paint or other coating.



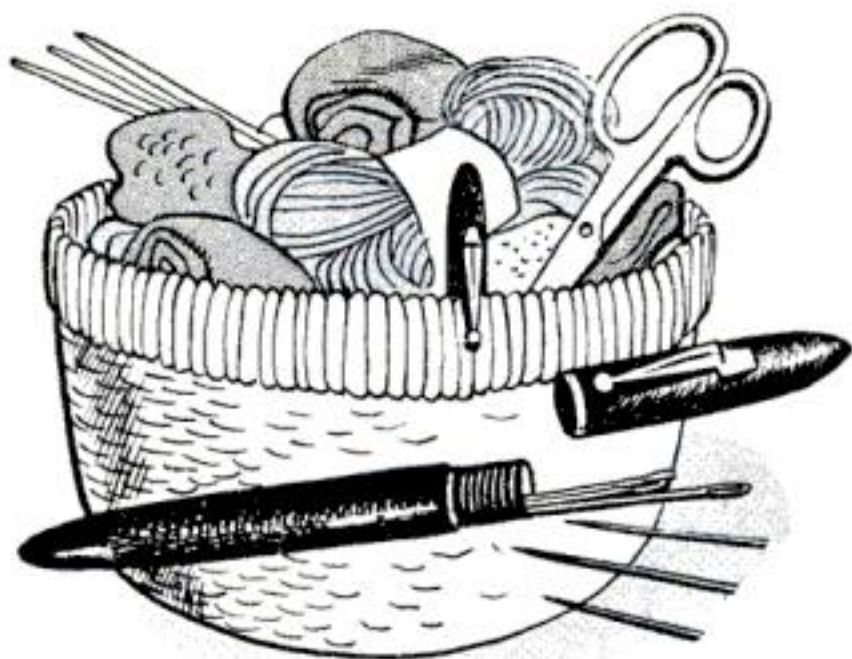
Glue a miniature calendar inside the cover of your checkbook as an aid in keeping accounts straight. It saves time and prevents errors in dating checks and reviewing bank statements.



Plastic screw caps from toothpaste and similar tubes make useful knobs for small objects. Cut off the lead neck of the tube and attach it with a wood screw. Then simply screw on the cap.



Hat racks made from coat-hanger wire and hinged inside a closet door help keep men's hats in shape and leave more space on closet shelves. Hold the wire with a clip and screw.



Pins and needles will be handy and safe if you keep them in the barrel of a fountain pen. Remove the point and tube. An old pen clipped in a purse is also good for carrying hairpins.



Gear-type can openers can be cleaned easily and thoroughly with a toothbrush. The bristles get into the small teeth and crevices to remove dirt that might not otherwise be reached.



Plastic pieces that have become dull can be polished with rouge lipstick. Apply the rouge to a clean cloth and rub it on with a circular motion. Buff with a bit of dry flannel.

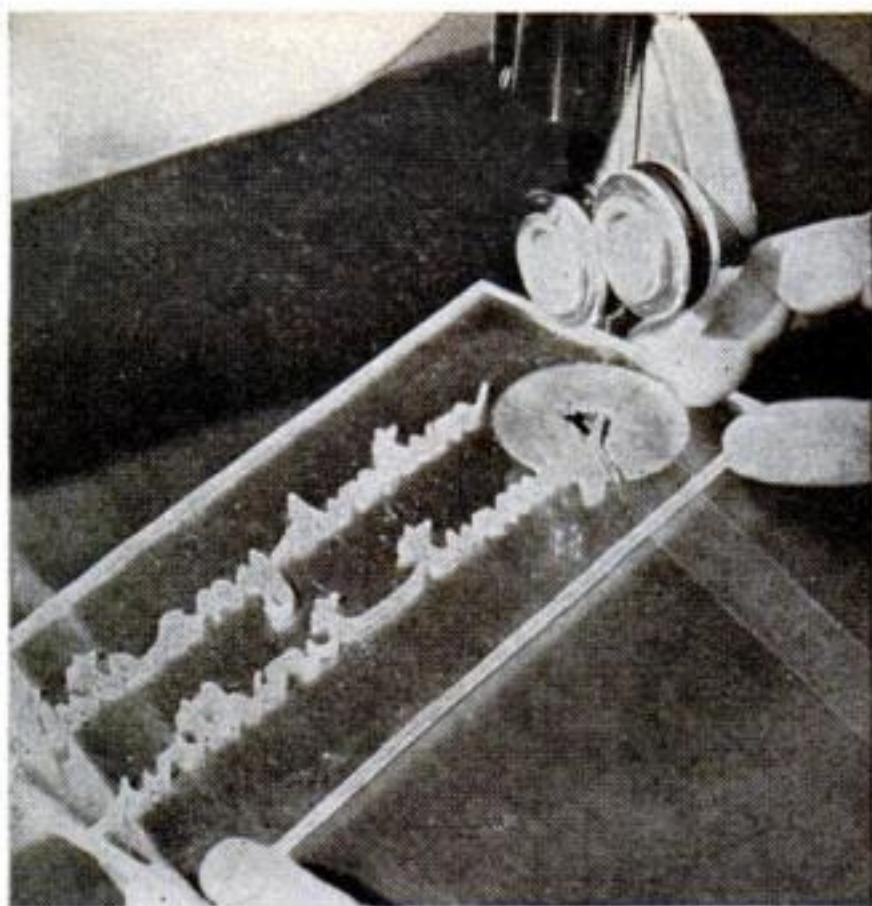
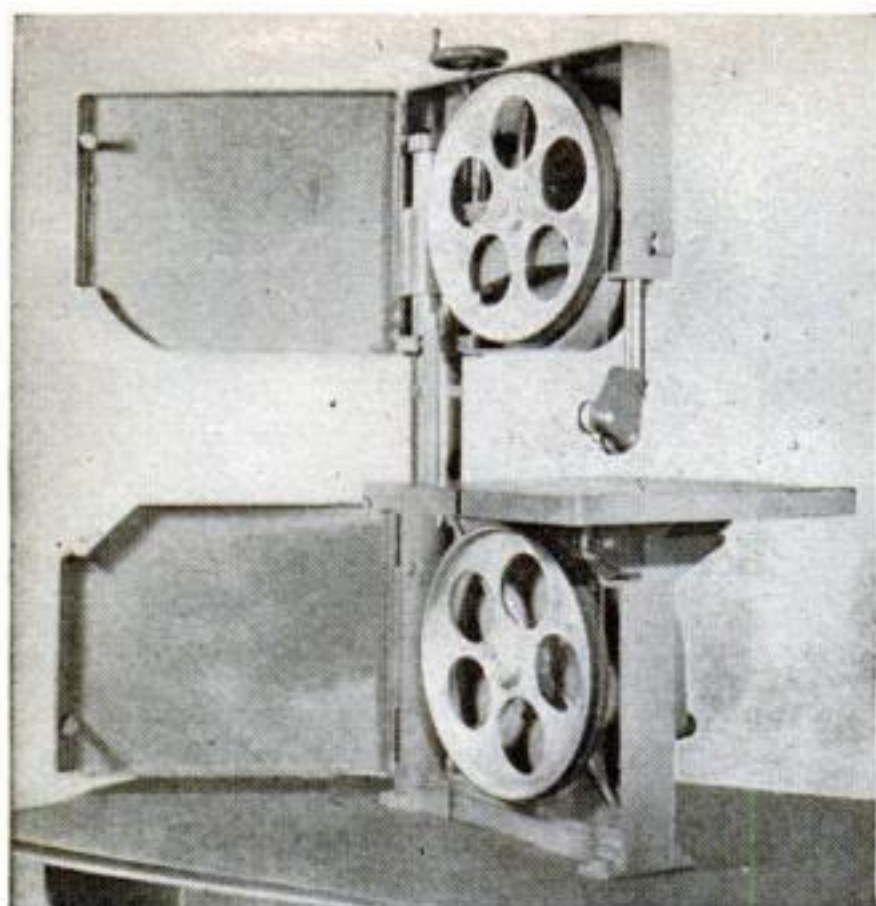


A few teeth filed in the raised back edge of a dustpan make a good comb for cleaning brushes. File the teeth about $\frac{1}{2}$ " deep and smooth off burrs that might catch the hands or clothes.



Breakfast in bed is more fun when you don't have to juggle a tray on your lap. An ironing

board of the folding type, used as shown, is a convenient substitute for a regular bed tray.



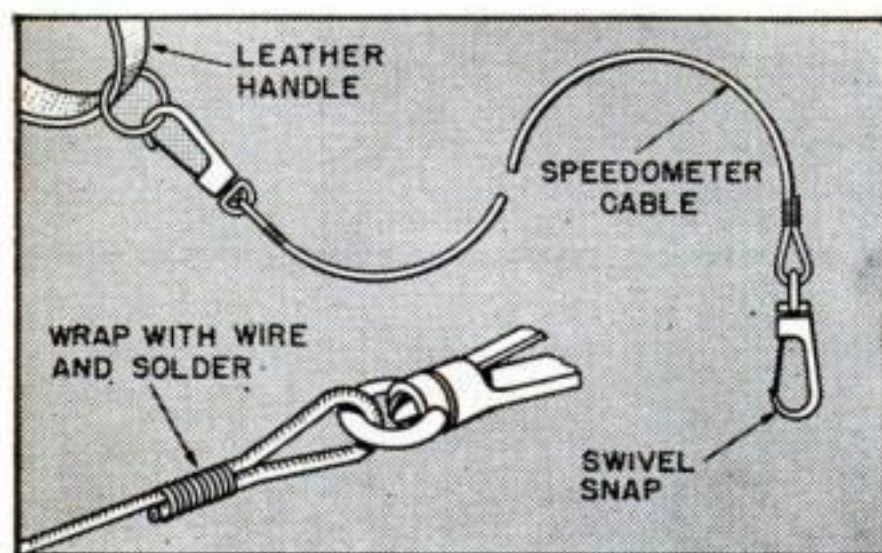
Spiral-Blade Bandsaw Cuts in Any Direction

CUTS may be made in any direction without turning the work when you use this spiral-blade bandsaw. You merely feed the work, guide the blade along the desired line, and it cuts any design that may be drawn on plastic, wood, or metal—even script letters as in the photo at the right above.

Made by the Tyler Manufacturing Company, of Santa Monica, Calif., the saw is 36" high and has a 12" throat. Since the work

need not be turned, designs that can be cut are not limited by the depth of the throat, as in conventional saws.

Roller-bearing assemblies with rubber tires maintain an even pressure against the blade. Mounted in drill-press fashion, the upper assembly has a 4" adjustment. The machine may be operated either from front or back, and four speeds are available through a four-step cone pulley.



Speedometer Cable Leads Dog

STRONG, flexible, and practically kinkless, an old speedometer cable can be turned into an excellent leash for your dog. Double back each end through the ring of a swivel snap, wrap closely with fine wire, and flow solder over the wire.

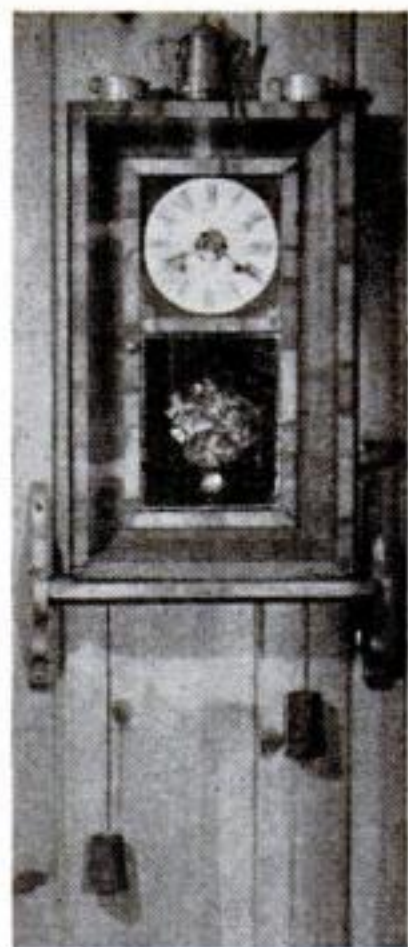
I also made a separate handle from a leather loop equipped with a small metal ring. Either end of the cable can be snapped to the ring or to the dog's collar. The result has been highly satisfactory.—*John G. Anderson, Pittsburgh.*

Clock Now Wound Less Often

MANY oldtime wall clocks must be wound every 30 hours, but this does not have to be so. You can lengthen the period between windings simply by lengthening the cords on which the weights depend.

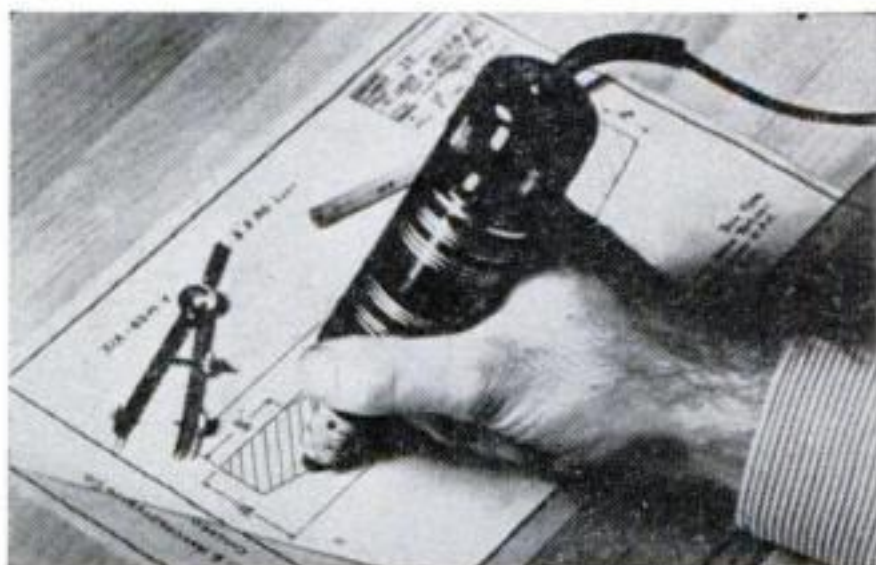
Drill $\frac{1}{2}$ " holes through the bottom of the clock in line with the outer edge of the top pulleys, pass cords of any desired length up through the holes, and tie them to the original cords after removing the weights.


Waxed casting line of 18- or 20-lb test is excellent for this. Replace the weights on the new cords, and the conversion is complete.—*Norbert Engels, South Bend, Ind.*

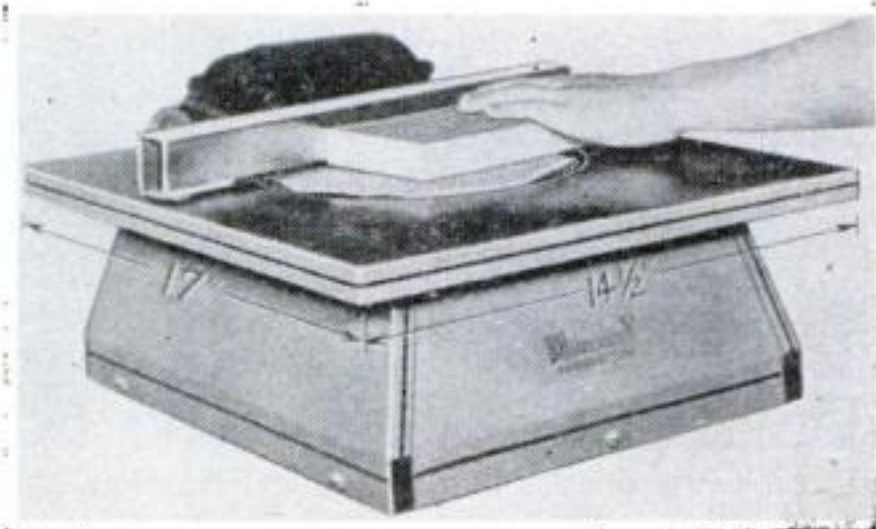




NEW TOOLS



Erasing by Power. Weighing only 12 oz., this electrically driven eraser is a new product of the Chicago Wheel & Mfg. Co., of Chicago. It embodies the same motor as the company's Handee Tool , and a quick-change chuck accepts standard erasers.



Sander Uses Square Sheets. A new horizontal sander introduced by Mastercraft Products, of Boston, has a 14½" by 17" working surface with an adjustable fence. It utilizes a "no gluing" disk for the abrasive that may be adjusted up or down to compensate for the thickness of the sheet. A 7" by 7" piece of any cloth-backed abrasive may be used. Without a motor, the tool costs approximately \$24.

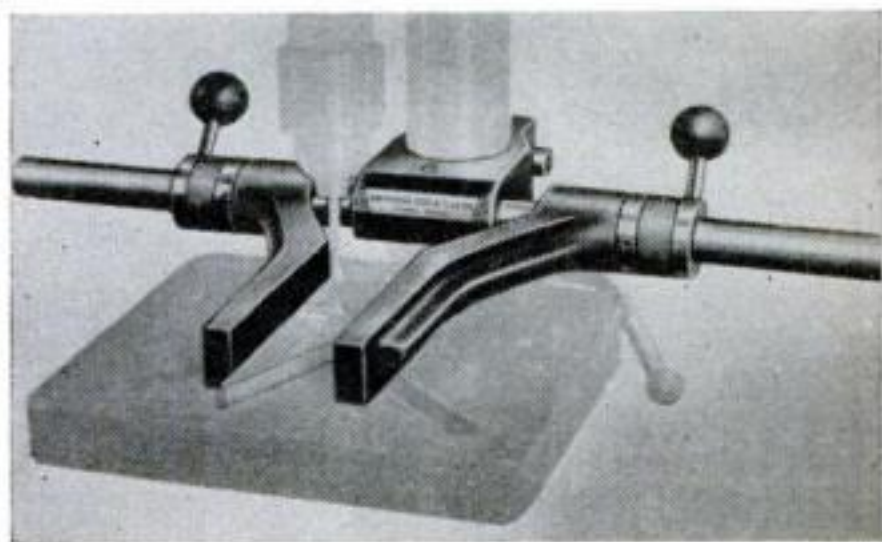
Drafting Aid Fits Pocket. Designed to enable draftsmen and others to make detailed sketches while away from their drawing boards, this small device combines the features of a compass, protractor, ruler, and T-Square. For use as a compass, one end has a free-moving pivot button. Made of clear plastic, it is a product of the Danat Company, of Chicago, and retails for about 50 cents.

Light Built In.

A 14" drill press introduced by the South Bend Lathe Works, of South Bend, Ind., has a built-in light with switch to provide shielded illumination for the work area. Both bench and floor models are in production, each having a capacity to drill ½" in iron or steel at the center of a 14" circle. The spindle has a maximum travel of 4" and speeds of 707, 1,305, 2,345, and 4,322 r.p.m. The depth

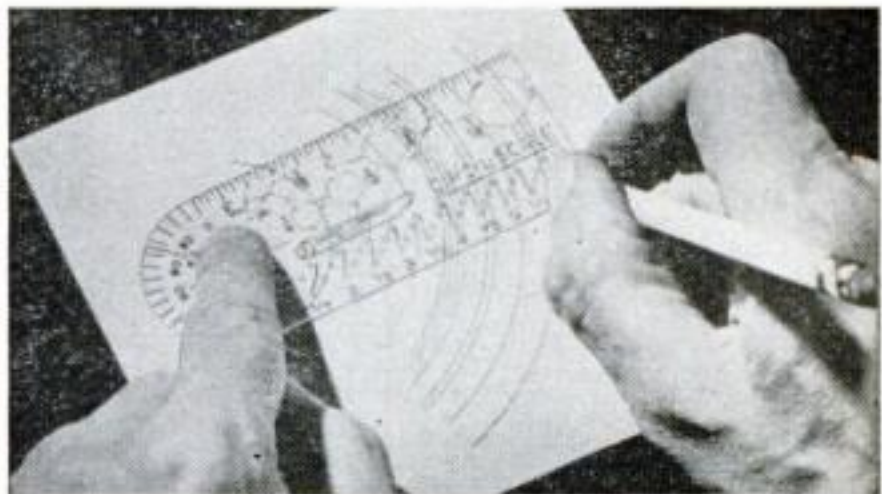


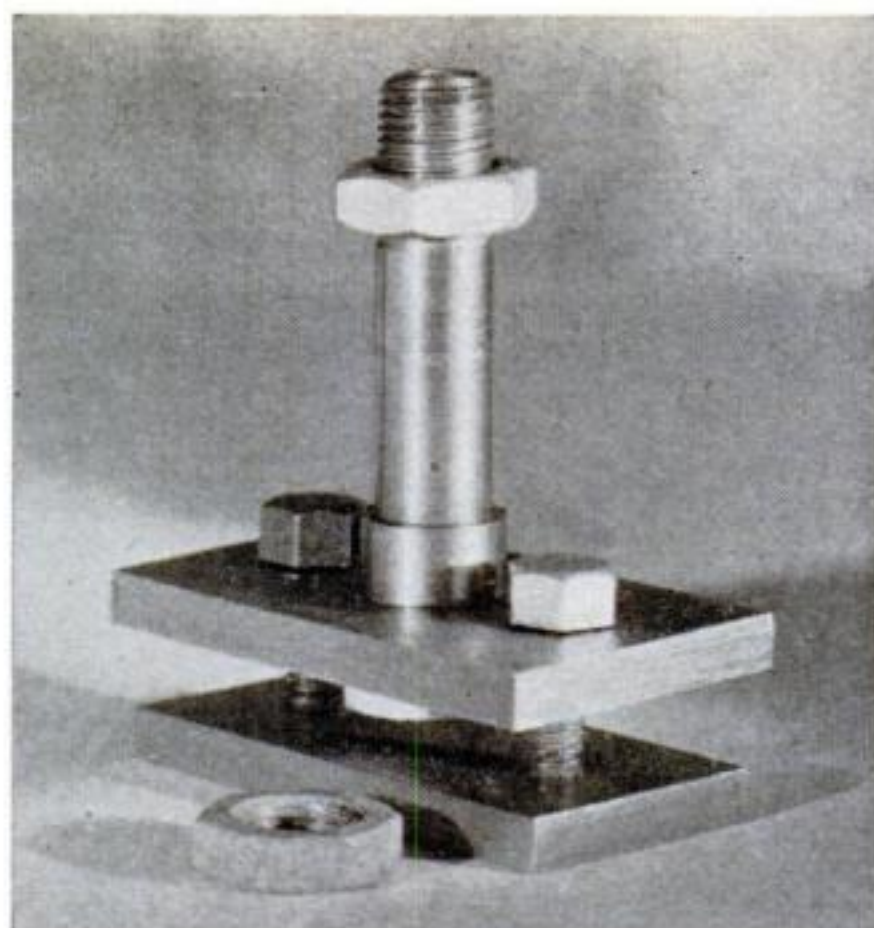
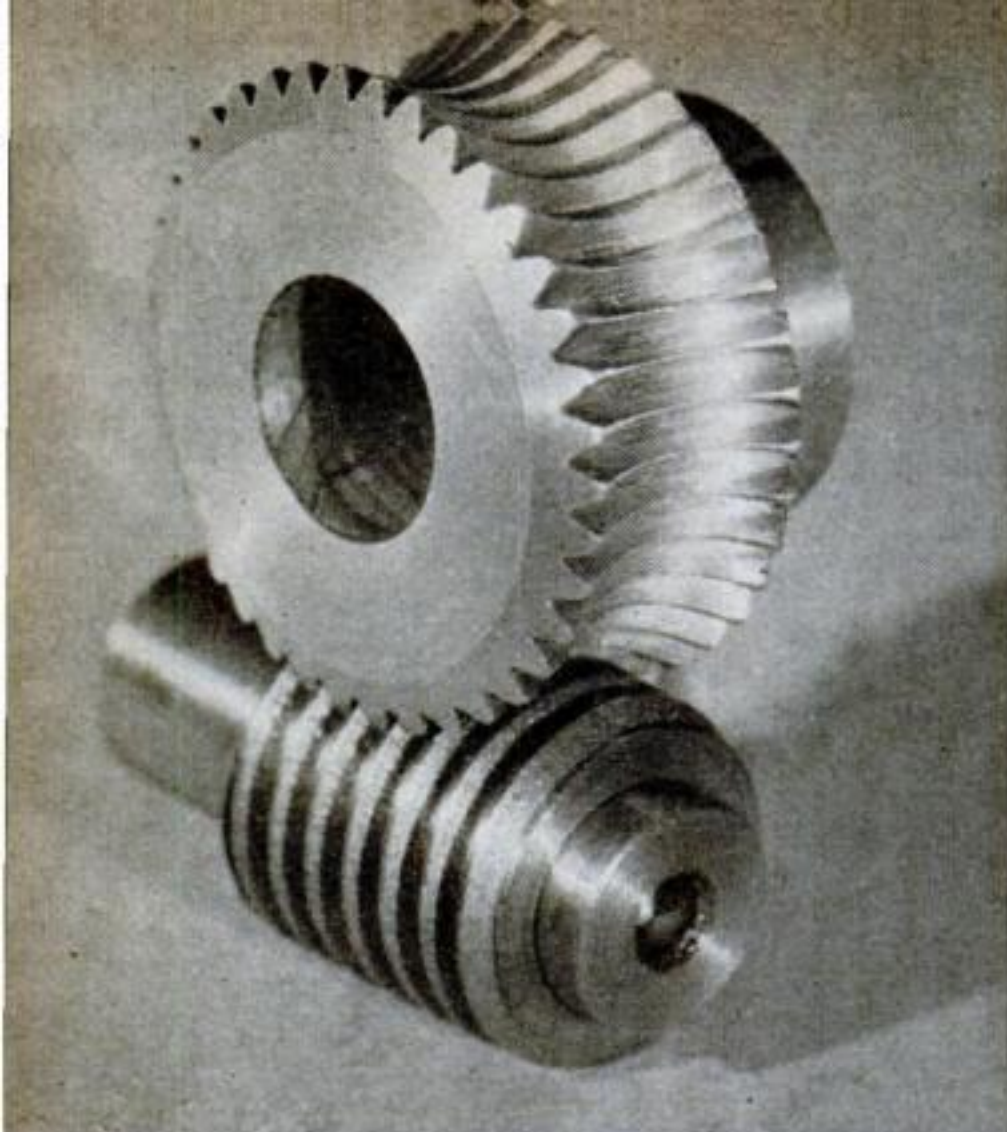
gauge, graduated in sixteenths, has adjustable collars to control both the depth of feed and length of return stroke.



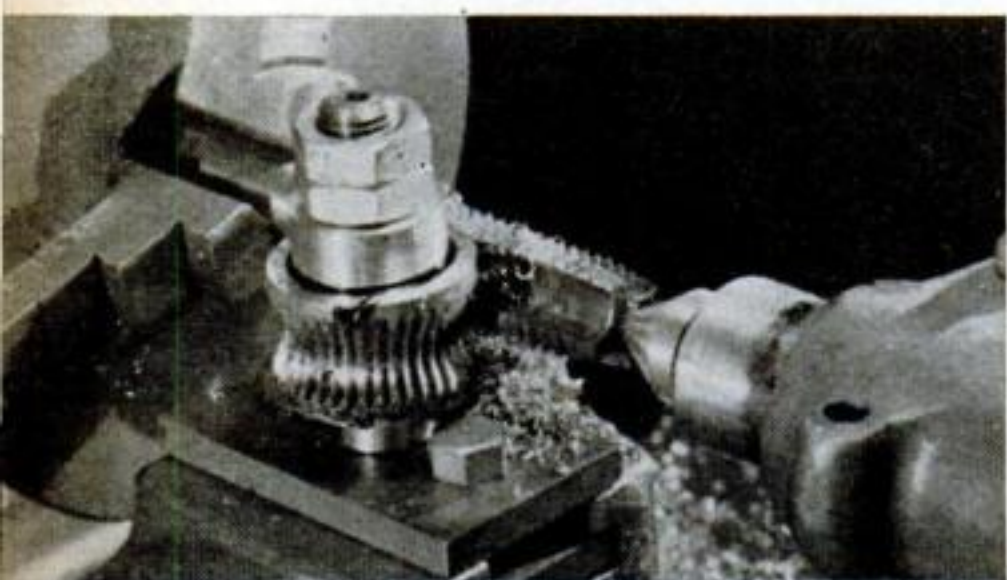
Holder Clamps to Drill Press.

A work holder developed by Universal Vise & Tool Co., Parma, Mich., clamps to the column of any small standard drill press and secures the work with a quarter turn of a single lever. The clamping arms are adjustable along the cross arm to encompass the full width of the table and may be swung up and back to clear the table for a drill jig or machine vise when necessary.

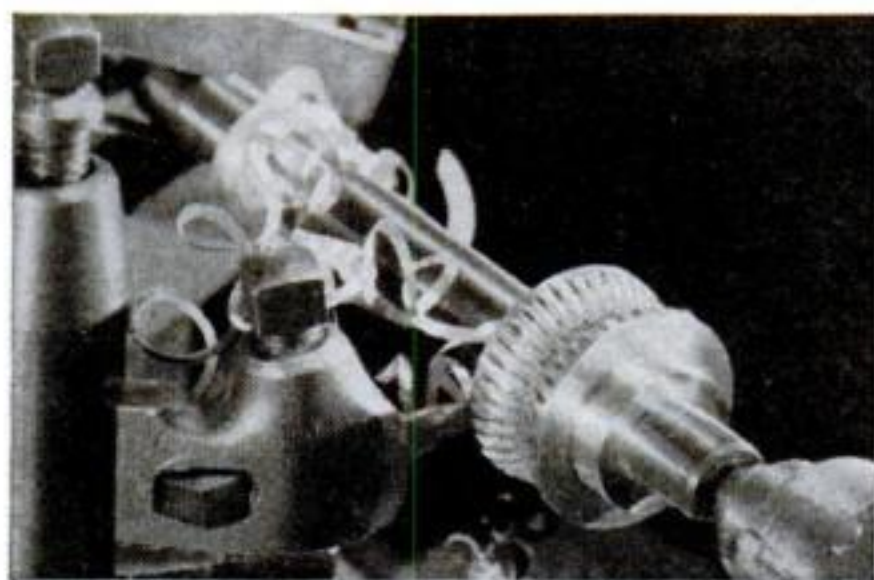




A hobbing fixture is made of flat stock, two bolts, and a threaded stud to suit the blank.



Blank must be at center height, free to turn. As tap teeth cut, lead of thread revolves it.



When teeth are full depth, gear can be mounted on an arbor to turn hub and chamfers on sides.

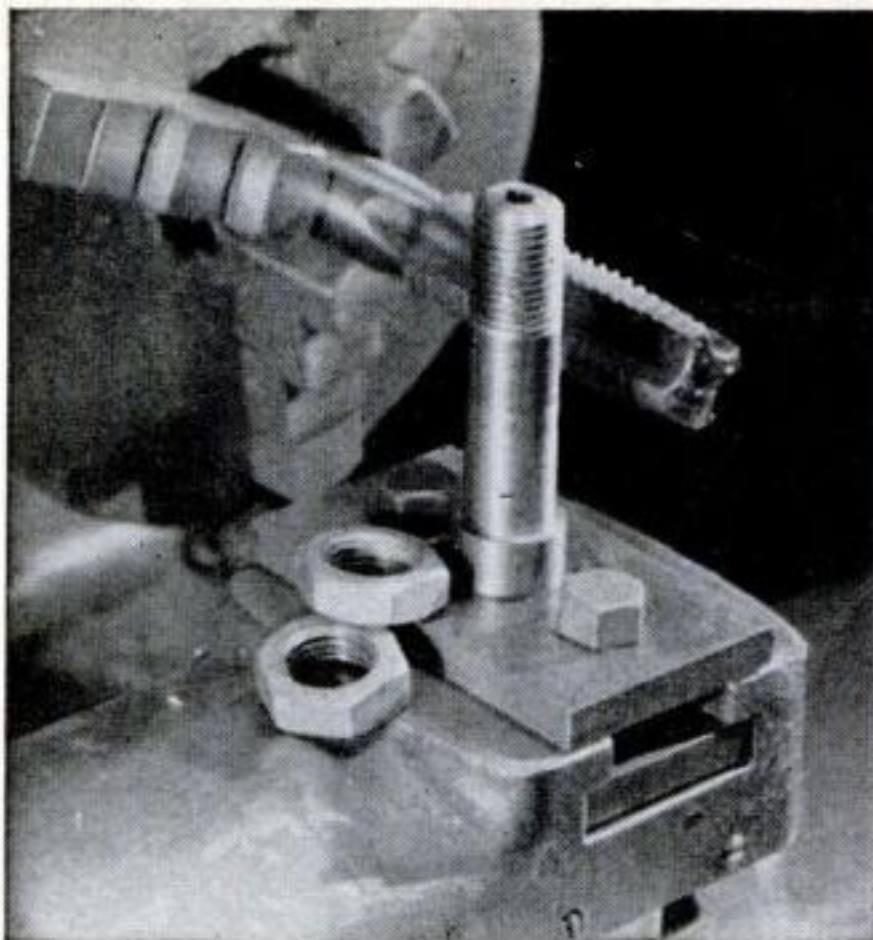
Making Worm Drives to Order

WHEN you need much speed reduction or great increase in torque, a worm drive may do the job more efficiently and compactly than a gear train. Calculation is easier, too, for the worm gear advances one tooth per revolution of the worm (in the common single-thread type). Thus the ratio is one to whatever number of teeth the worm gear has. Well suited to models, light machines, and sensitive controls, worm drives can be made up as you need them, even on a lathe without screw-cutting gears, by using a tap as the hobbing cutter.

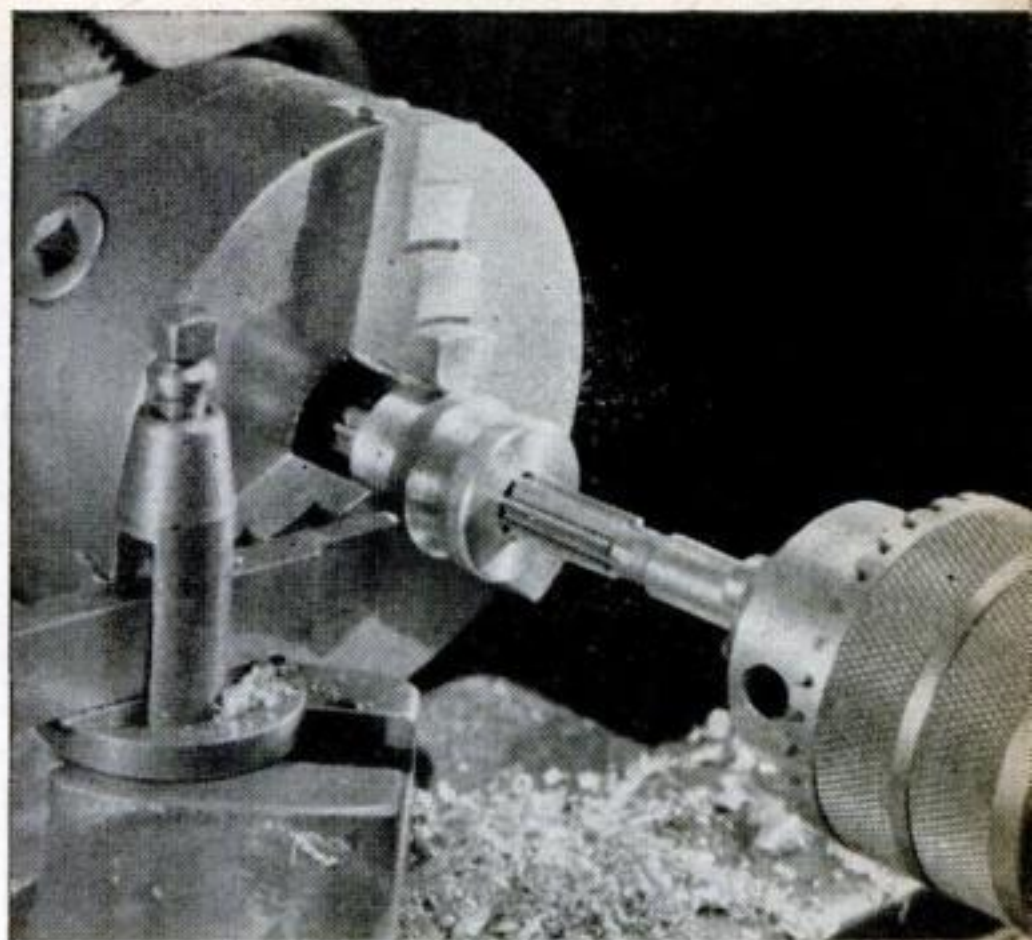
The worm can be made from a screw of suitable pitch simply by drilling a shaft hole

and providing a setscrew, pin, or key. You can, of course, turn a special worm blank and cut the teeth with a die.

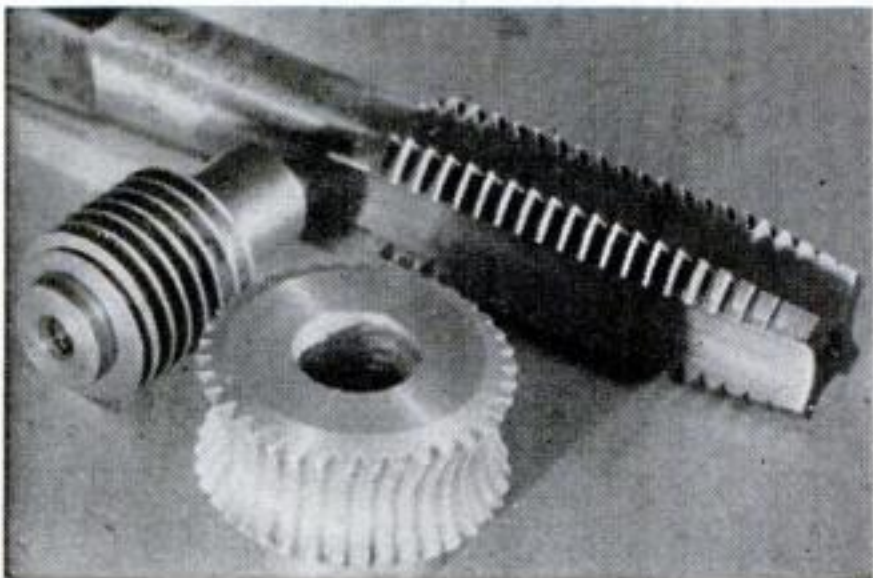
For the gear, a blank must be turned to a diameter on which the tap will generate the required number of teeth, and with a radius matching that of the worm. Multiply the number of teeth wanted by the pitch (distance between two threads on the worm) and divide the product by pi (3.1416). Now deduct the thread depth (see PS, Feb. '45, p. 185). Say a 1:40 drive is wanted, to use a 7/16"-14 screw as the worm. The pitch is 1/14", or in decimals .0714". Multiplied by 40 this gives 2.856", which divided by pi



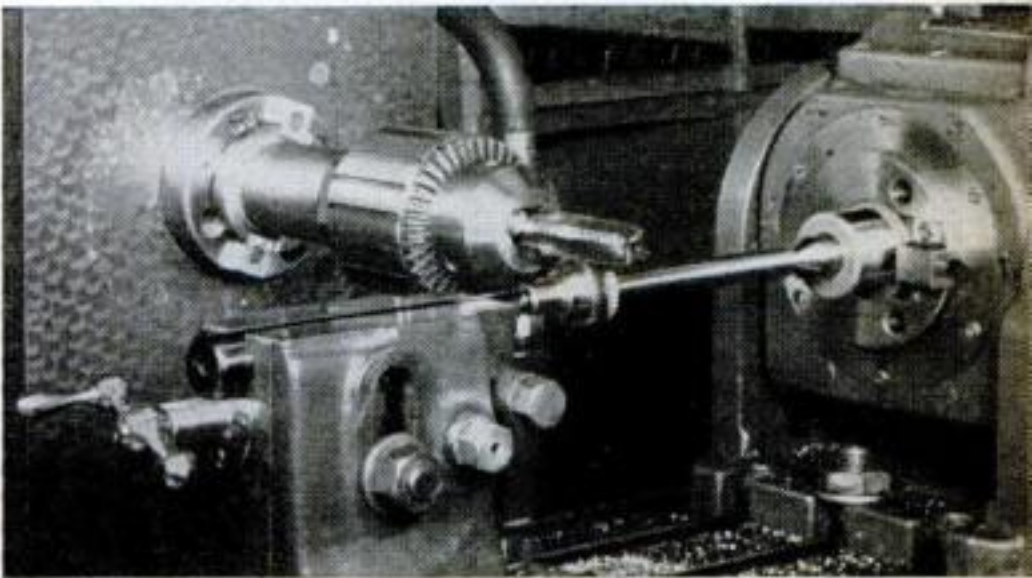
Replacing the tool post, the fixture clamps on the compound rest. Hobbing tap is chucked.



Gear blank, turned beforehand to the proper size and radius, is reamed to fit fixture stud.



A hub is turned on a common screw to make the worm, shown with gear and the hobbing tap.



Hobbing can be done the same way on a milling machine. Here too, blank must be free to turn.

gives .909". Subtracting thread depth, or .046", gives .863" as the blank diameter.

This is the diameter of the blank in the throat—that is, measured at the bottom of the radius. It's best to leave the radius a bit larger, so the tap teeth will touch at the throat diameter first, and let the cutting edges form the correct curvature.

The photos above show a fixture on which the blank is mounted. Two bolts clamp it on the top slide, and two lock nuts secure the blank. For very light work, you can use a flat plate that slides into the compound-rest slot and is tapped to receive a bolt. A hex-head bolt with part of the shank unthreaded will do. The blank is slipped on this with spacer washers above and below, and as the bolt is tightened into the shoe it clamps everything fast. Adjust the spacers so that the blank remains free to turn but has little or no up-and-down play, with the

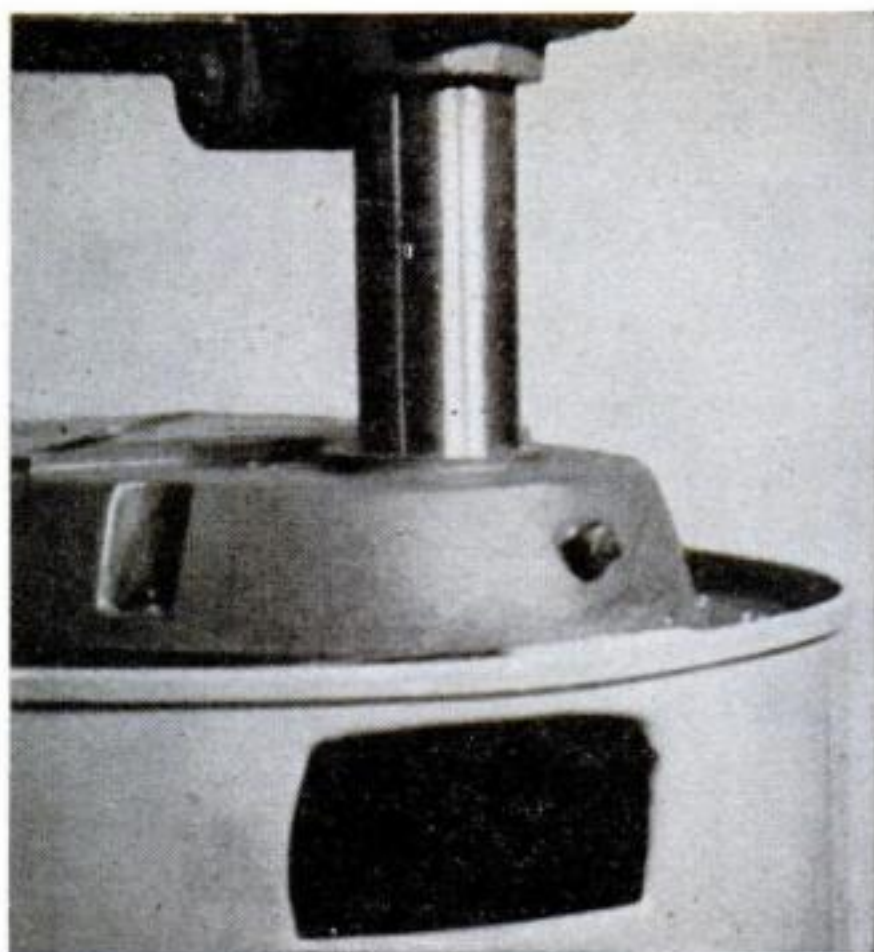
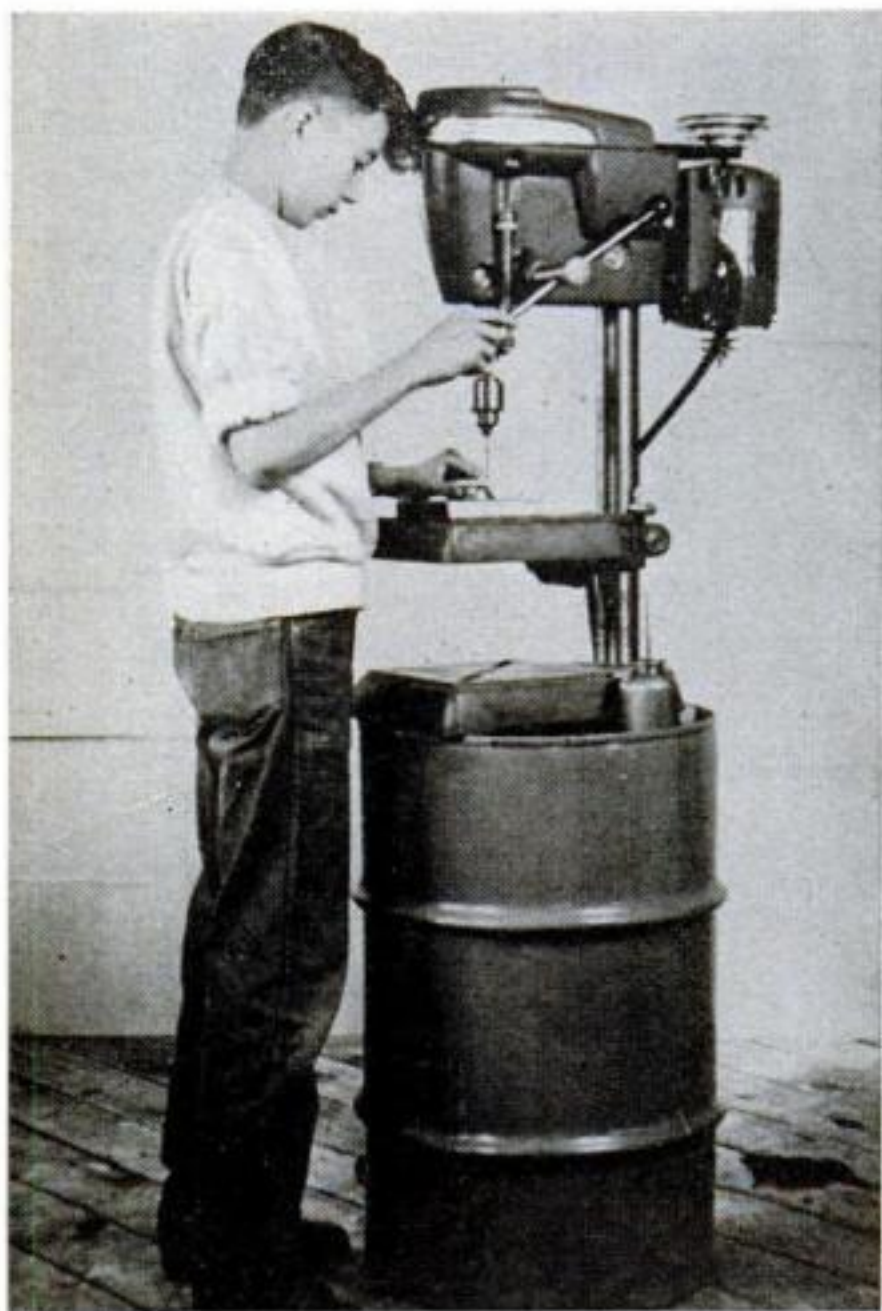
throat diameter at exactly center height.

The tap, mounted between centers and driven by a dog or else chucked and supported by the tailstock as shown, should turn at slow speed. Carefully feed the blank against the revolving tap. As it begins to cut, the lead of the screw should turn the blank. With coarse teeth, it may be necessary to start the blank turning, but as soon as a shallow bite appears, the blank will continue turning of itself. Use lubricant or a cutting oil as you would for threading. Feed the blank in a distance equivalent to the standard depth of the thread used.

Lock the carriage when hobbing. It helps start the teeth to run the blank back and forth against the stationary tap, thus "knurling" shallow cuts. Fine teeth start more readily than coarse. If the blank falters once it has started to turn, it has "lost step" and may have to be discarded.



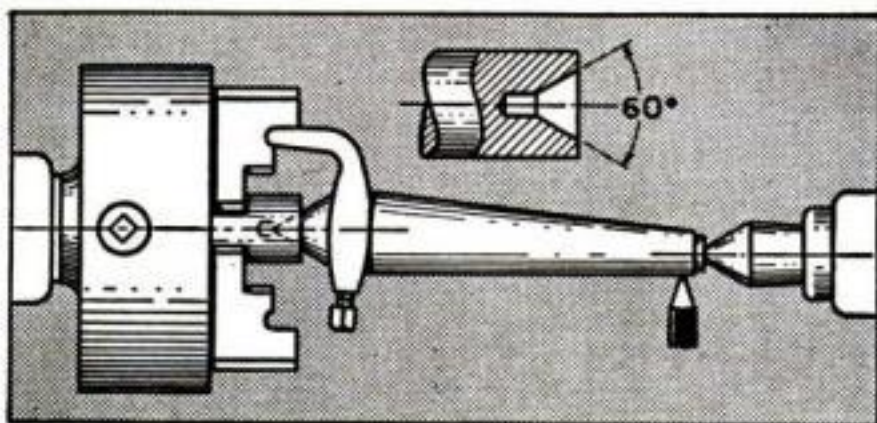
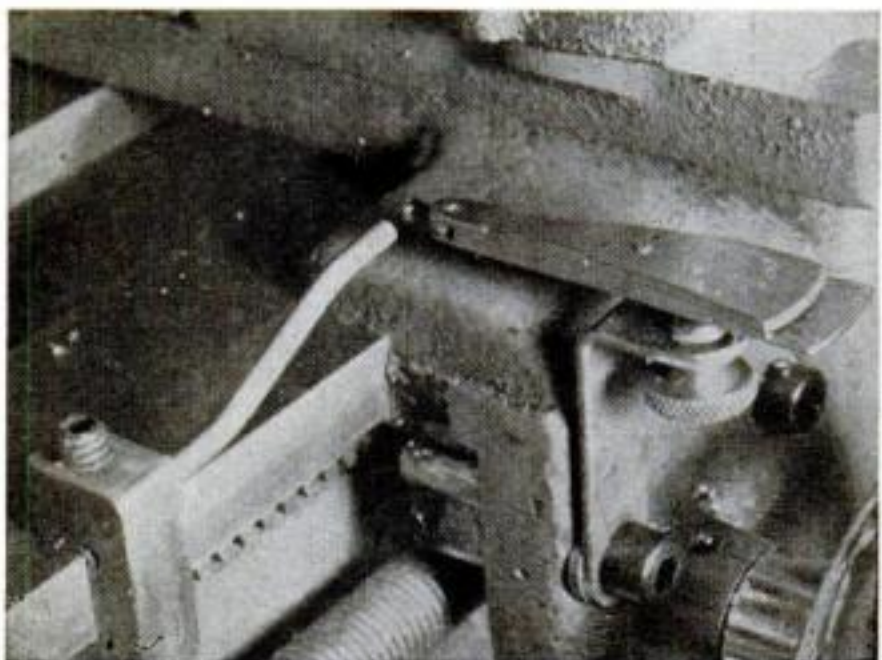
NEW SHOP IDEAS



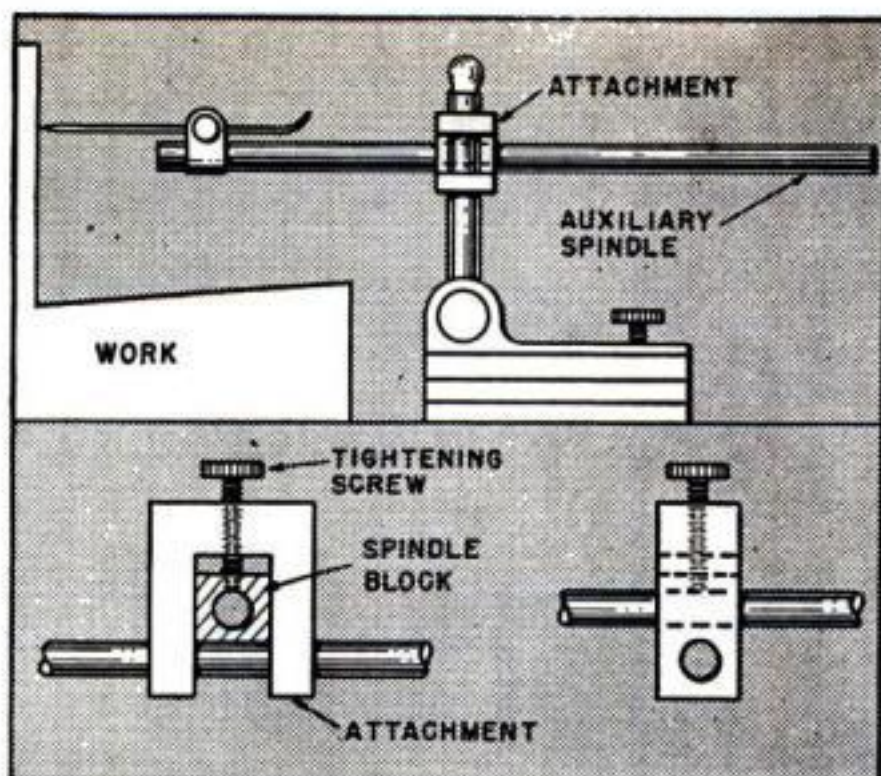
Drum Becomes Machine Stand.

Old oil drums, filled with sand to get stability, can be turned into sturdy, shipshape machine stands. The 30-gal. size seems about right for such tools as a drill press, tool grinder, or disk sander; the 55-gal. size is best for bigger machines. A hand hole cut with a chisel near the top will give access to the nuts for the machine mounting bolts, and will afford an easy way of putting in the sand. Bend back the cut edges for safety.—*Wilber H. Fulker, Colorado Springs.*

Indicating Carriage Travel. Better than a simple carriage stop for many facing, boring, and recessing jobs, an indicator mounted directly on the lathe carriage (below) lets you perform these tasks with delicacy and precision. The contact feeler on the indicator bears against a rod held in an ordinary carriage stop, while the indicator is attached to the apron by a bracket.—*John M. Avery, Delhi, N. Y.*

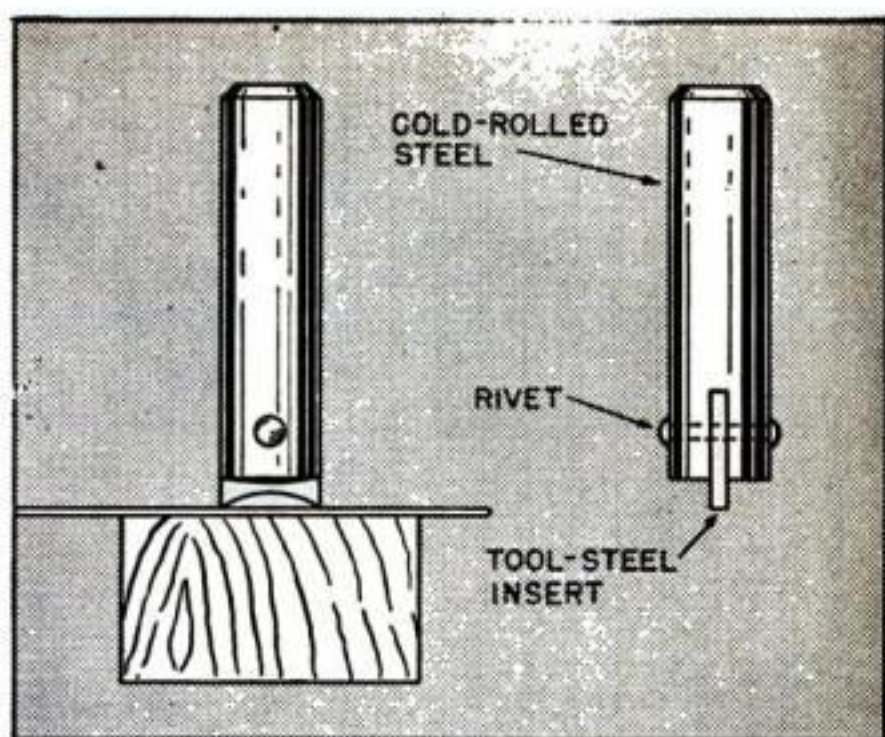


Using Hollow Centers. In reclaiming old lathe centers, or in machining other pieces where center holes cannot be drilled in both ends, the setup shown above comes in handy. With the tailstock offset it is of course impossible to chuck the work directly, but chucking a hollow center to hold the work and driving it with a lathe dog will give excellent results. Make the hollow centers from cold-rolled steel, truing each one up with a light cut whenever it is rechucked. Although a big centerdrill in the tailstock may give fair results at truing, it's preferable to set the compound at 30 deg. and true with the compound feed.



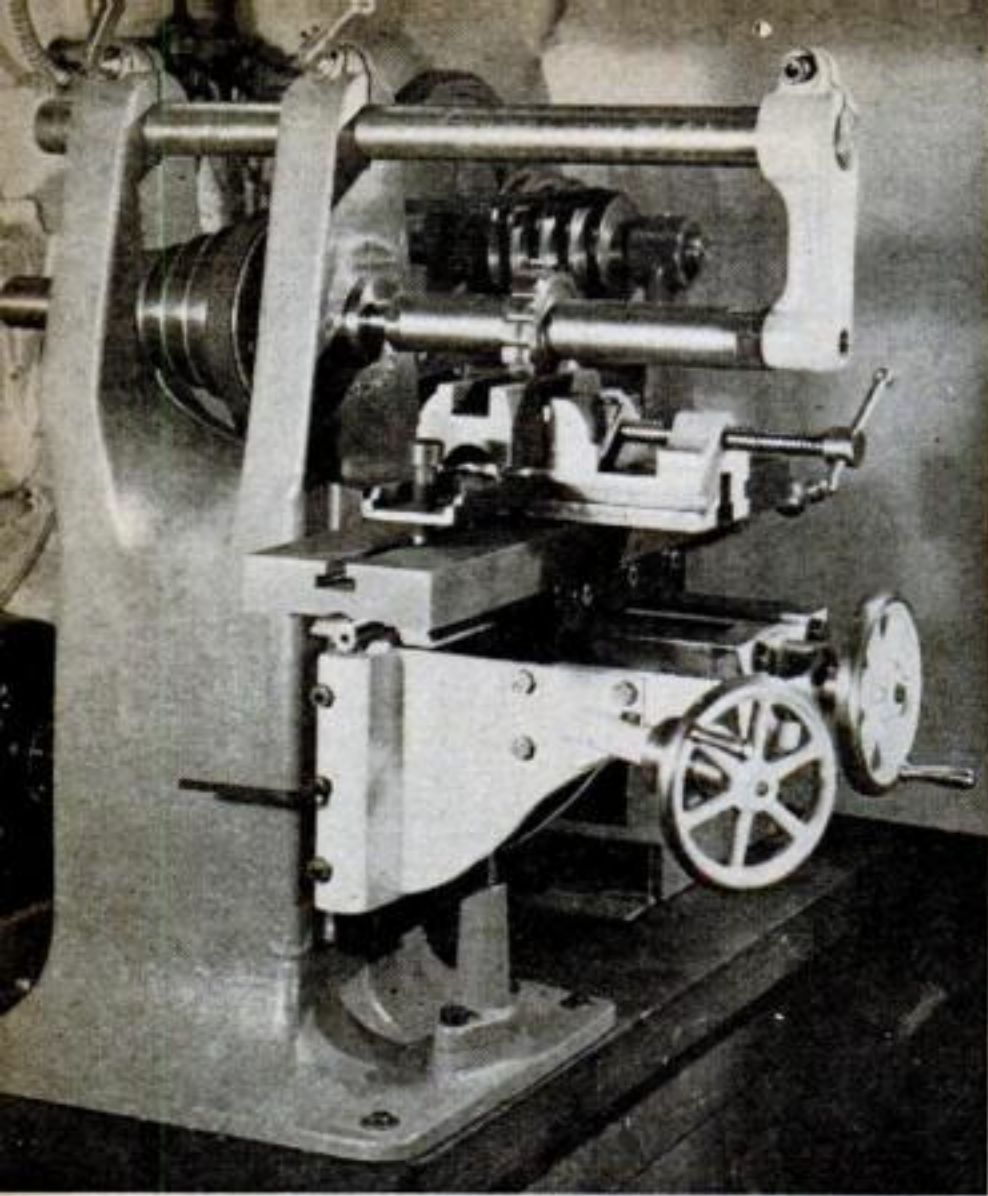
Increasing Surface-Gauge Reach. With some work a surface-gauge scribe cannot be brought against the face, and the usual expedient of placing the gauge on a number of parallels is often a bit unsteady. To reach these long-distance parts, I use a piece of drill rod the same diameter as the surface-gauge spindle, holding it in a steel yoke inside which is a square block that slips over the upright. A single screw holds the rod in the block and the block against the spindle. Any reasonable distance can be scribed if the gauge is balanced by a rod long enough to reach well behind the tool.—*Harry Moore, Leeds, England.*

Homemade Welder Cart. Tired of lugging assorted equipment and supplies around the shop with my small transformer-type welder, I built the cart pictured at the right. The cabinet beneath the welder holds all necessary equipment, and on the back rod holders cut from conduit contain a good supply of various welding rods. The handle and frame are bent up from $\frac{1}{2}$ " electrical conduit with brazed joints, and the cabinet built of birch. A pair of 2" by 8" wheels carry the cart. I finished off the job with four sprayed coats of lacquer, which seems to give better protection against spatter than does enamel.—*John G. Lownsbery, Richmond, Va.*



Punch Cuts Slots. Useful in sheet-metal work, modelmaking, and preparing radio chassis, this punch will cut a clean slot with one or two hammer blows—much faster and easier than by the drilling-and-filing method. It can even be used to cut special rectangular or triangular openings. The cutter, which should be tool steel, may be made by annealing and cutting a blank from an old wood saw, filing it to shape, rehardening it, and riveting it in the sawed notch of the steel shank. Don't omit the curve of the insert, which gives a shearing action to the cut. End grain of a hardwood block makes a good backing surface during punching.—*Richard Salzer, Baldwin, N. Y.*





Finishing and Setting Up a Bench Mill

Careful lathe work is called for in machining the running parts of this versatile little milling machine.

By Walter E. Burton

MAKING the spindle is one of the most precise operations involved in building the milling machine begun last month. So that the spindle will fit the bearing bores snugly but not tightly, the outside diameter must be held to close tolerances, this diameter being 1.2501" plus or minus .0003".

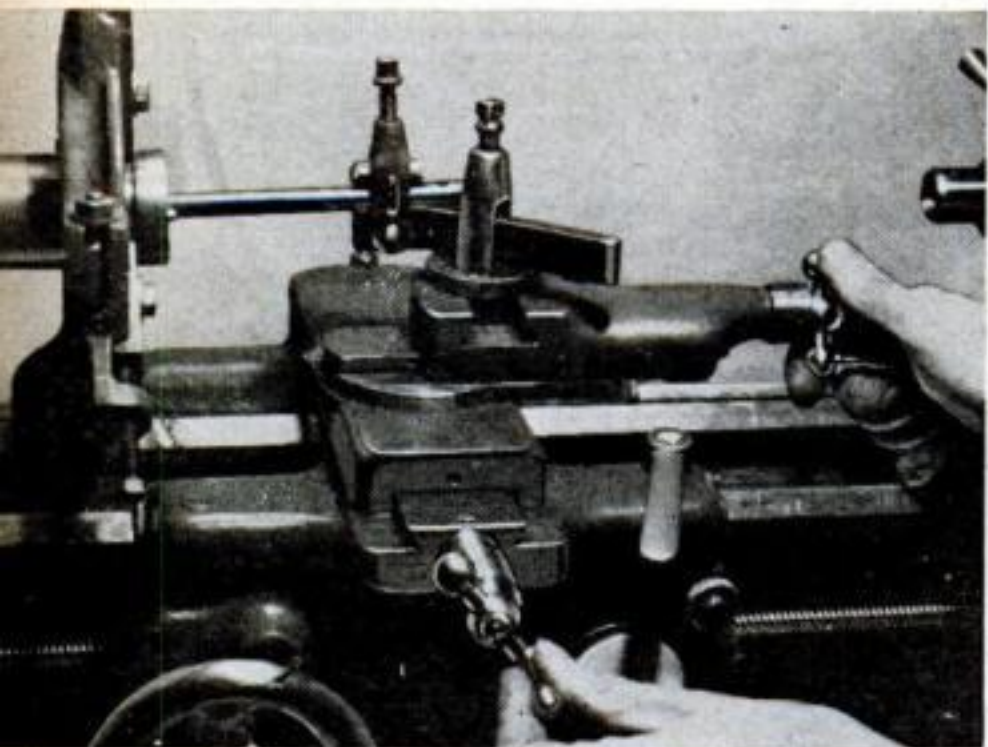
For the workshop fan, such finicky operations are a challenging part of any job. And this one will present several—even though you begin with semifinished castings, as I did, and work from blueprints supplied by the manufacturer. When it's completed, you'll have a machine that opens many new opportunities for your shop—at about a third of the cost of a similar mill bought ready to go.

Make the spindle from steel tubing or rod. At this point came several variations that I introduced to make the mill more suitable for my particular requirements.

Instead of making the spindle the length specified, I made it 9" long to give extra thread at the back for later addition of an automatic-feed gear. Furthermore, instead of using two lock nuts on the spindle, I made a threaded ring about $\frac{3}{4}$ " long, split it with a radial saw cut, and provided two 6-32 fillister-head bolts to lock it on. Such a ring can be adjusted with greater precision for controlling end clearance.

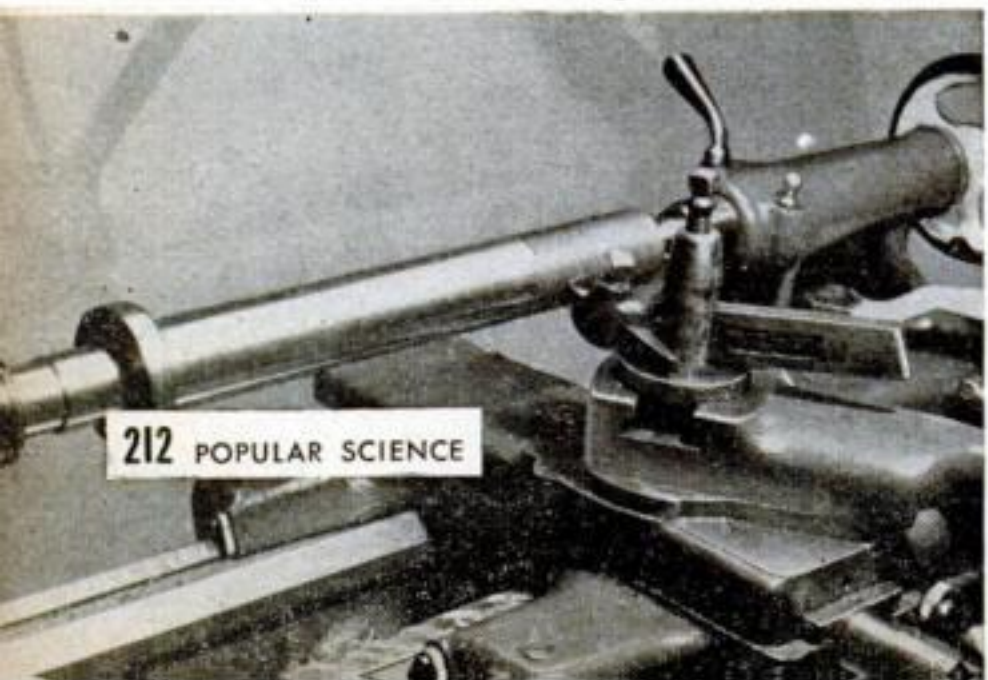
Clean out the recesses bored in the main casting, coat them with a film of thin oil, and tap the bearing cups into position with a plastic hammer or a suitable drive ring. The

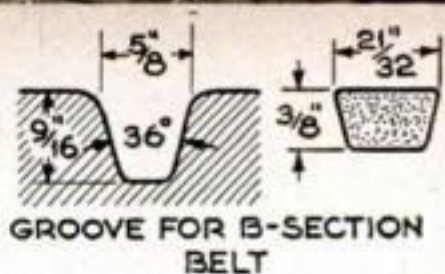
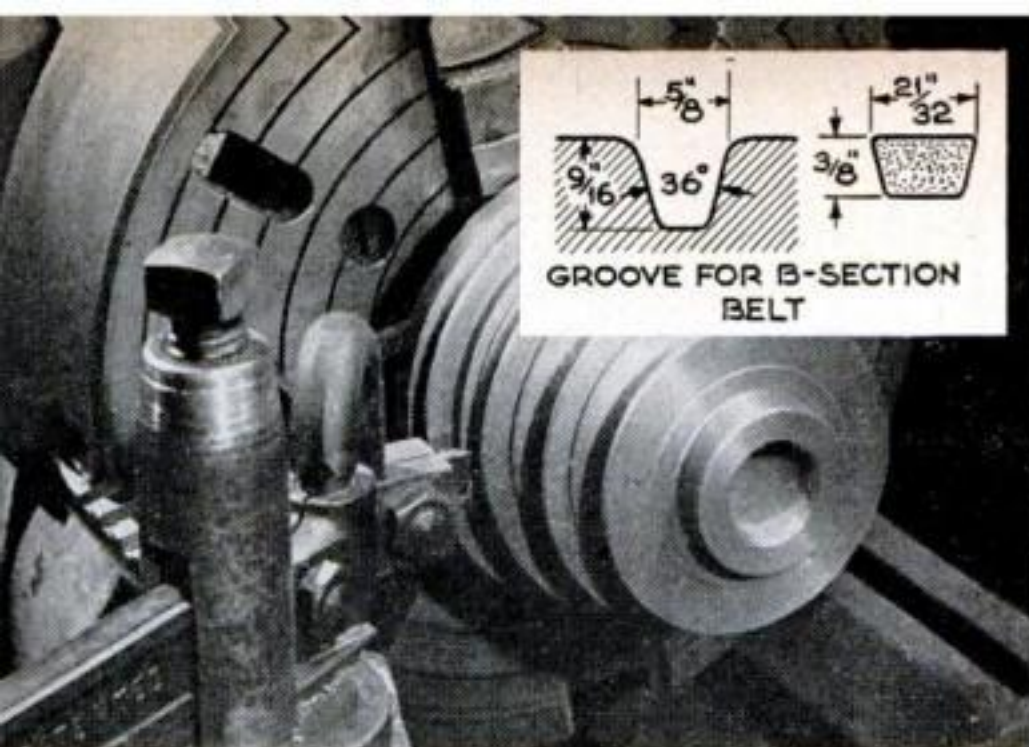
The completed mill set to cut a channel in a steel block. A drill-press vise holds the work.



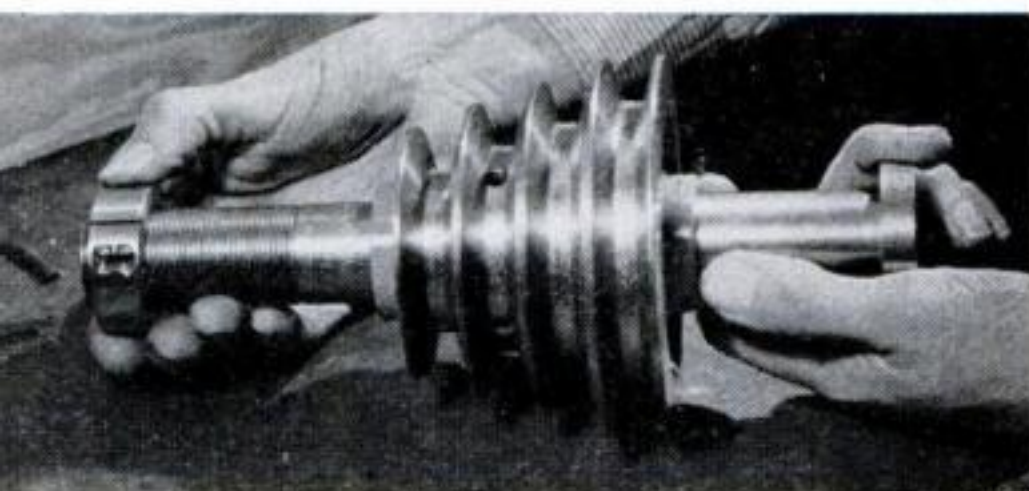
A tapered hole was bored in the spindle while it rotated in the steady rest, the work being fed by the compound rest set to the taper angle. A lashed lathe dog drives the other end.

Threads were cut on the spindle by mounting it between the tailstock center and a tapered mandrel in the headstock. The same setup was used for machining the spindle to diameter.





V-belt grooves may be cut in the cone pulleys with a cut-off tool. Dimensions suitable for a B-section belt are indicated in the sketch.



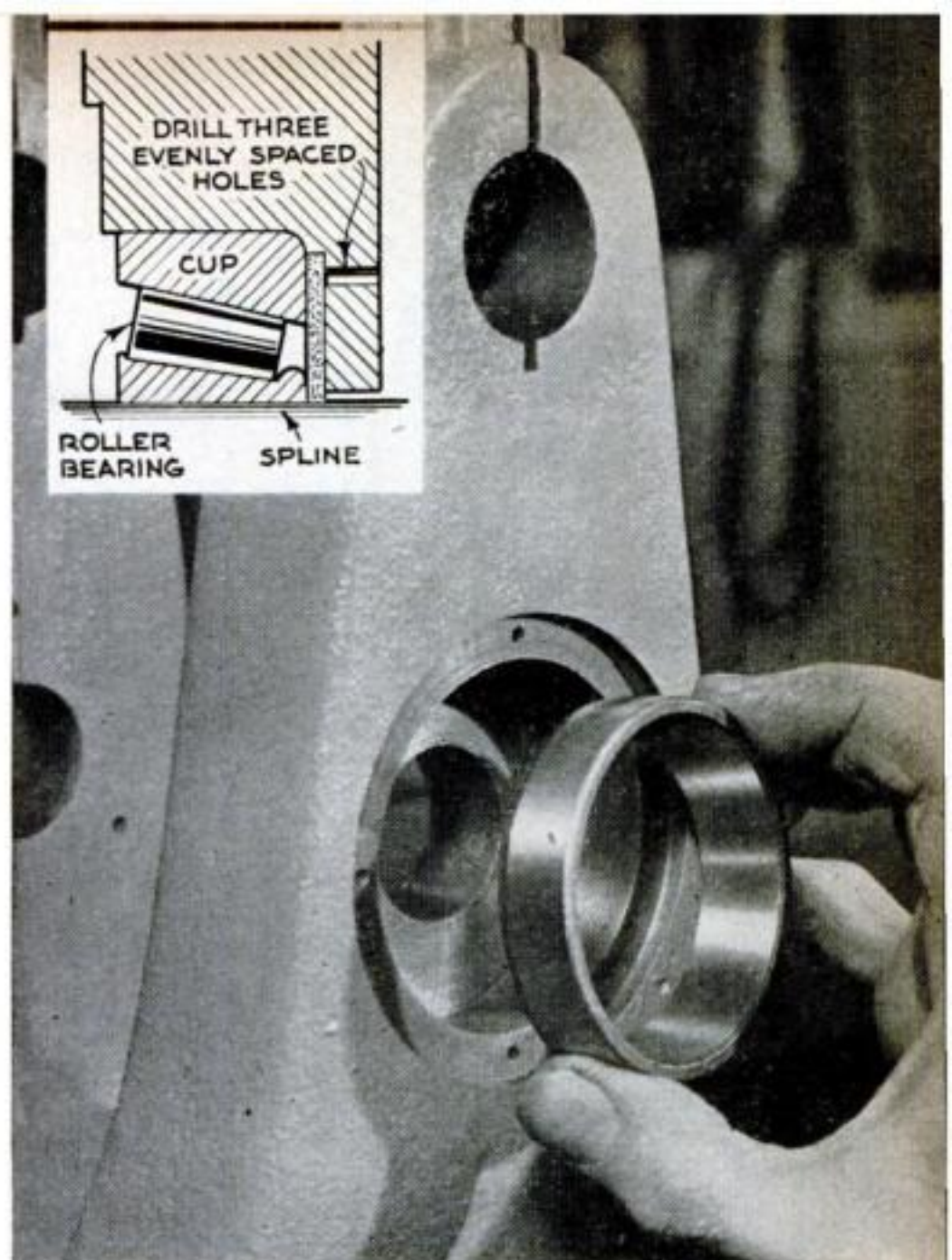
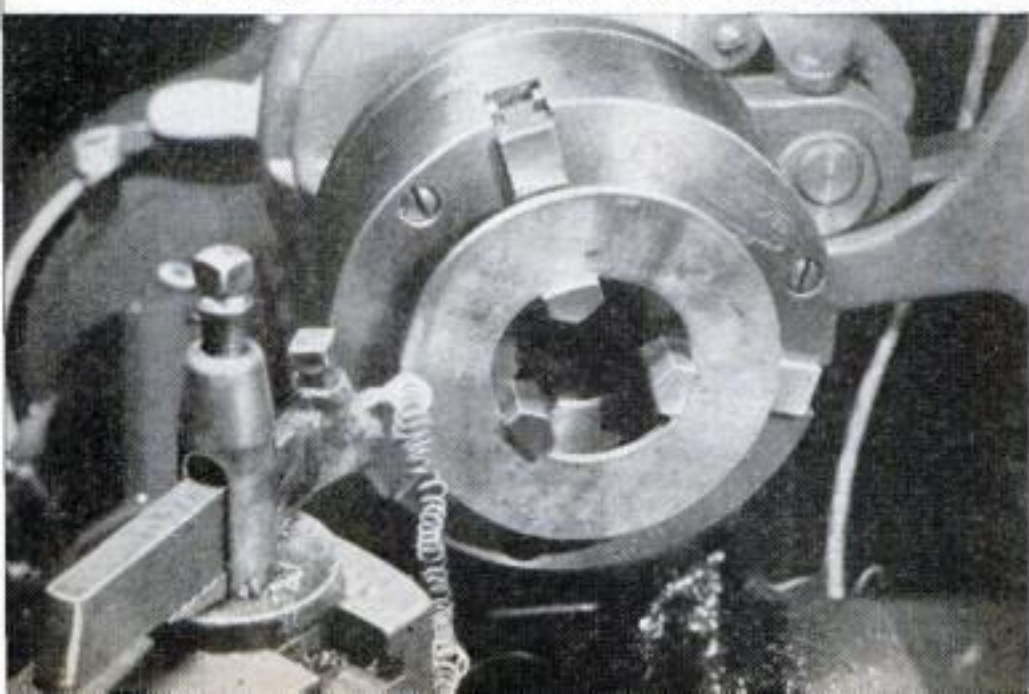
Here's the spindle assembly with the pulley in place and the split nut being threaded on. Note the two 6-32 locking screws in the nut. Two setscrews hold the pulley to the shaft.

recesses in the casting should be relieved at the inner faces to permit felt dust seals to be installed.

In machining the bearing covers, an improvement is to recess the inner face of each to take a thin felt washer that will form a dust seal around the front end of the spindle and around the retaining nut at the rear. Cement the washers to the cover plates with an oil-resisting adhesive.

There are various ways of machining the spindle. What I did was clean out the bore to slightly larger than $\frac{3}{4}$ ", drive a plug into

Cover plates for the two roller bearings were machined to the desired outer diameter as seen below. The plates were chucked in outside jaws for machining the inner diameter.



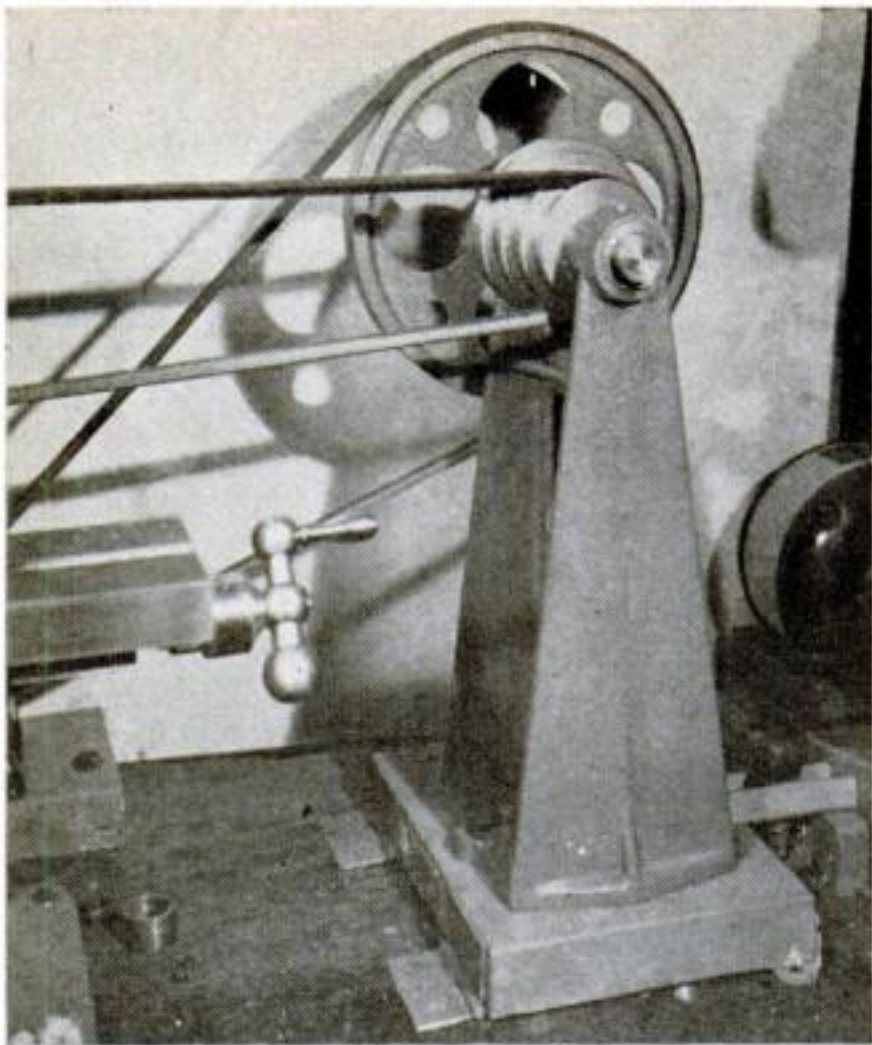
Three knock-out holes drilled as in the drawing will make the roller-bearing cups easier to remove if replacement is necessary. Coat the recess with oil before tapping in the cup.

one end, drill a center hole, and attach a dog. Supporting that end on a center with the dog lashed to the faceplate, I placed the other end in a steady rest and bored a No. 3 Morse taper hole. A steel bar taper-turned to fit the lathe spindle was tapped into it, and a No. 3 Morse taper turned on the protruding end. Then the milling machine spindle was placed so its taper socket engaged the bar, its other end being supported by the tailstock center.

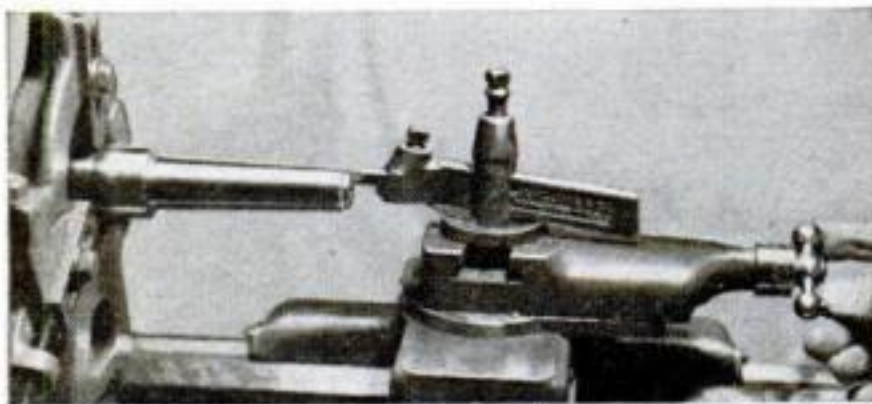
A standard cut-off tool may be used to machine the four-step V-belt pulleys from

Four screws hold each bearing plate in place, the holes being drilled with the plate itself as a template. The inner face of each plate was recessed for a thin dust-seal washer.

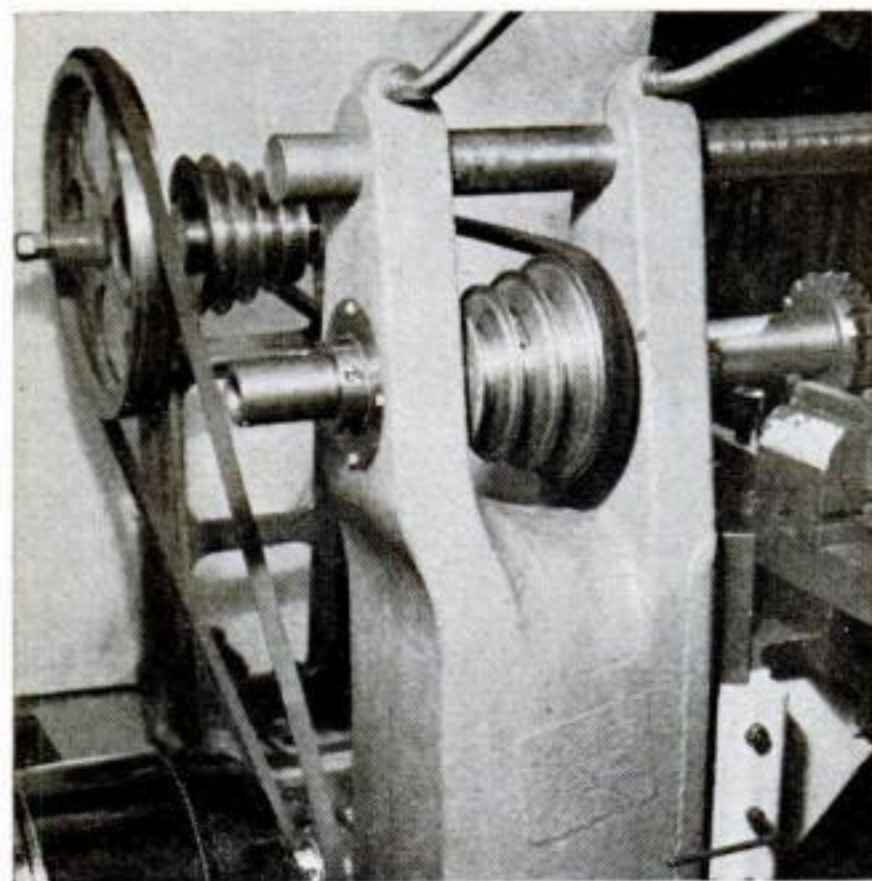




A hinged base makes it possible to swing the countershaft toward the mill to release belt tension. A bolt-button device locks the base.



Taper the arbor at one end to fit the spindle hole of the milling machine. It's desirable to make an arbor for each standard cutter size.



At the rear, the mill looks like this. Use a $\frac{1}{8}$ - or $\frac{1}{2}$ -hp. motor, and for convenience mount the control switch at the front of the bench.

the rough castings, the blade being set to protrude from its holder a distance equal to the groove depth desired. First mount the casting in a four-jaw chuck with the larger end outward. Face off the end and true up the hub portion. Then reverse the casting, with the chuck jaws grasping the hub, and bore the hole to $1\frac{1}{4}$ " diameter.

Grooves may be formed by making a central cut with the cutoff tool to the depth required, the compound being set at the angle desired for one of the sides. In this case, 18 deg. was used, or a total angle of 36 deg. Feed the compound back and forth to cut one side of each groove. Then reverse the compound and cut the remaining sides.

For maximum trueness, you can mount the sheaves on a true-running mandrel, take light finishing cuts with a sharp bit, and then file and polish. Although each sheave should be keyed to its shaft for maximum strength, two $\frac{5}{16}$ " setscrews placed 90 deg. apart to engage flats on the shaft will be adequate for most purposes. The screws extend through the second smallest groove.

One of the cone pulleys is mounted on a shaft that rotates in plain holes bored in the countershaft casting. In semifinished castings, these holes are already bored. But if you're using a rough casting, you can bolt it to the carriage of the lathe and drill holes about 1" diameter. Then mount a boring bar between centers and bore the holes to size by adjusting the cutting bit outward for successive passes. Also face off the areas around the holes so the pulley ends will have true bearing surfaces.

You probably will find it advisable to obtain the large countershaft pulley wheel already turned and reamed, for in the rough state it is a bit hefty for a small lathe. Along with a V-groove sheave on the motor shaft and an A-section or B-section belt, this wheel forms a V-flat drive. If you wish you may substitute a grooved sheave on the countershaft, producing a full V-drive.

Although a collar is indicated for the countershaft, the two pulleys will hold the shaft in position if the casting is faced off so they run smoothly. Considerable end play is permissible if the two cone pulleys are aligned properly, the "floating" action sometimes being quieter than a tight fit. The ratio of the motor and countershaft pulleys may be about 7:1.

Because a V-belt should always be slack when it is changed from one cone-pulley groove to another, the countershaft in this

case was mounted on a heavy wooden base hinged along the edge nearest the mill and provided with a hold-down arrangement at the opposite edge. This consists of a bolt installed in the bench top, a button made from channel steel, and a supporting block.

Slots in the base of the countershaft casting permit it to be shifted to offset belt stretch. However, the tilting arrangement could be designed to perform this function by blocking up the button-edge initially with a strip of wood that is, say, $\frac{1}{2}$ " thick. As the belt stretches, substitute thinner strips.

End mills may be mounted by grasping their shanks in collets tightened by a drawbar extending through the spindle, exactly as in a lathe spindle. A keyed chuck on a No. 3 Morse taper arbor will hold small end mills, drill bits, etc. Always lock the chuck in the spindle by a drawbar. This may be a $\frac{1}{4}$ " threaded steel rod engaging a threaded hole in the end of the arbor, the other end being equipped with a handwheel bearing against a sleeve in the spindle hole.

Standard milling cutters like those seen in some of the photos are usually mounted on an arbor tapered at one end to fit the milling-machine spindle hole and turned at the other to a $\frac{1}{2}$ " diameter to fit the bronze bushing in the overarm bracket.

Collars to space the cutters on the arbor are best machined from steel tubing. They should be of various lengths. It is important that the ends be faced off square.

Oil the overarm bearing each time you insert an arbor into it. Also remember to oil all other parts of the machine frequently. The spindle bearings should be packed with lubricant designed for roller bearings.

When the machine is ready for a trial run, check it carefully to see that everything is performing with the required precision.

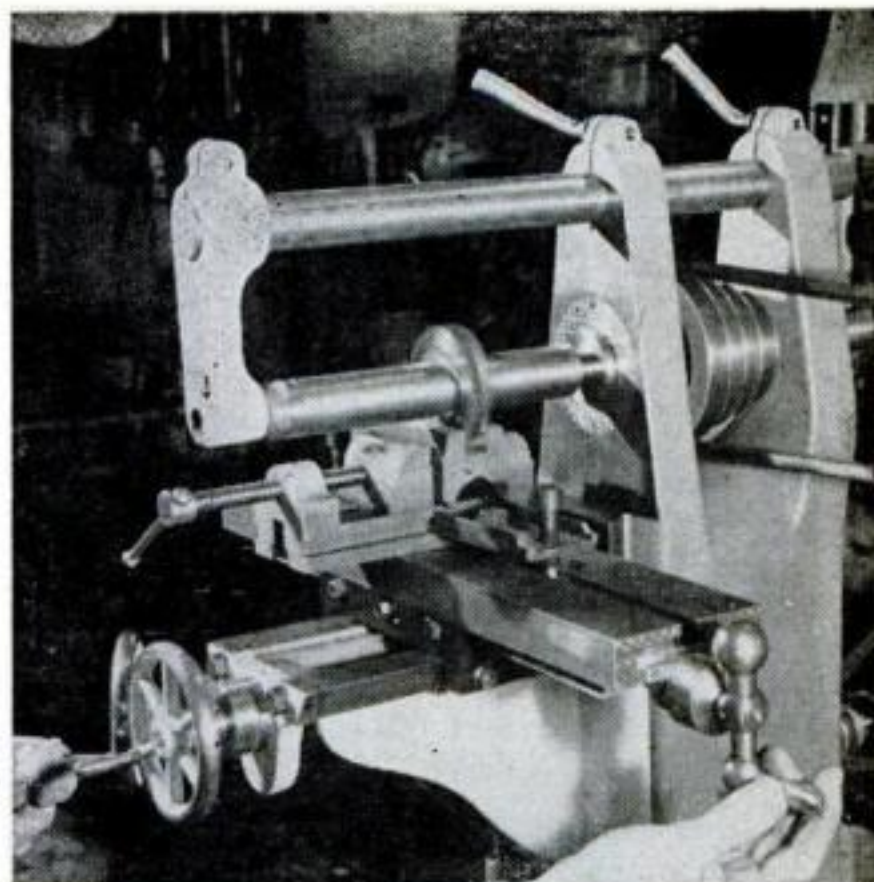


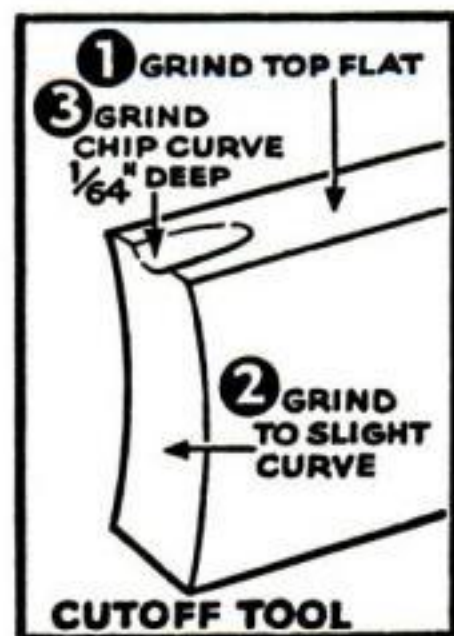
Table feed is controlled by a crank located at the right-hand end. However, the crank may be placed at the other end if you prefer.

Here a dial indicator is handy, for it can be mounted to gauge the trueness of table travel, etc. You can bring the dovetail slides to a high degree of perfection by careful manipulation of a metal scraper and judicious use of abrasive cloth and sticks. Adjust the gibs so the parts move with minimum of play, but do not bind. The center gib screw of the vertical slide should have a handle or knob so it can be used as a locking screw when occasion requires. Equip all other gib screws with lock nuts.

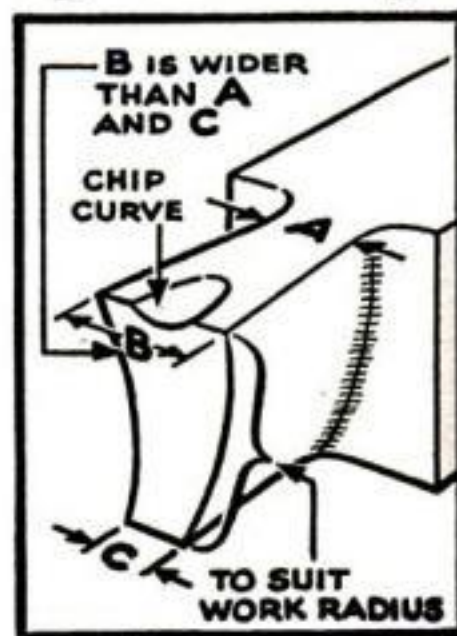
Work is held on the table by a standard milling vise, or by any other suitable clamping arrangement. In the setup shown on page 212, a vise is held by two pivoted steel plates, the center pivot being a bolt whose head engages the T-slot. The outer ends are supported by cap screws pressing against the bottom of the slot.

END

Cutoff and Trepanning Tools Break Up the Chips



EVERY machinist has run up against the bugaboo of chips clogging the slot while a cutoff or trepanning tool is being used. I have found that tools ground as shown in these sketches give excellent results. If mounted just a trifle above center, the slight curve on the cutoff tool avoids chattering and digging in. In either tool, grind the chip curve $\frac{1}{64}$ " deep or less—never more. The trepanning tool was made from a tool bit. If the heel drags, grind a trifle to provide clearance.—R. J. Wright, Bartow, Fla.



Shoot with One Light

If carefully placed, a single spot will yield portraits with dramatic shadows and brilliant high lights.

By Louis Hochman



A midget spot with a "snoot" to narrow the beam will yield shots like this.

CONSIDERING the variety of spots, floods, booms, and other lights used in making a single big-time advertising picture, an amateur photographer may wonder how he ever could hope to do good work with his own limited supply of lighting units. Yet some of the most striking pictorial effects are produced with just a single light.

One light, judiciously applied to a subject, packs a wallop that is hard to maintain when more are introduced into the composition. The strong contrasts between light and dark areas, the dramatic shadows and brilliant high lights, and the simplicity of composition all tend to heighten the effect and make the picture more forceful.

One-light photography is good training for more advanced work. You are forced to try all possible angles until you find the one that yields the best result. In this way, you unconsciously develop your skill in placing the key light.

You can use any spotlight from the large studio variety down to the tiny Dinkie Inkie [®], or even a reflector-type flood. To control the beam of a photoflood, roll a tube about 10" long from thin cardboard and slip this over the bulb. Don't burn the light too long or the tube may catch fire. Use a "snoot" to

narrow the beam of the spotlight.

By posing a subject against a black background and training the beam of a midget spotlight on his features from various angles, you can produce a variety of effects. For such shots be careful of the nose shadow. If it reaches the mouth, the effect usually will be unsatisfactory, and it's generally best to angle the light so the shadow covers only about a third of the distance between the nose and the upper lip.

You frequently can glamorize a girl model by directing the light straight into her face from directly in front, regardless of the direction in which her head is turned. Weird effects can be achieved by placing the spotlight on the floor with its beam on the subject's face, and interesting profile shots by edge-lighting your subject from behind. In the latter case, be careful not to let the light strike directly into the lens.

In most cases, especially if black backgrounds are used, one-spot photography will yield fairly contrasty negatives. For this reason, it is a good idea to process the films in a soft-working developer.

END

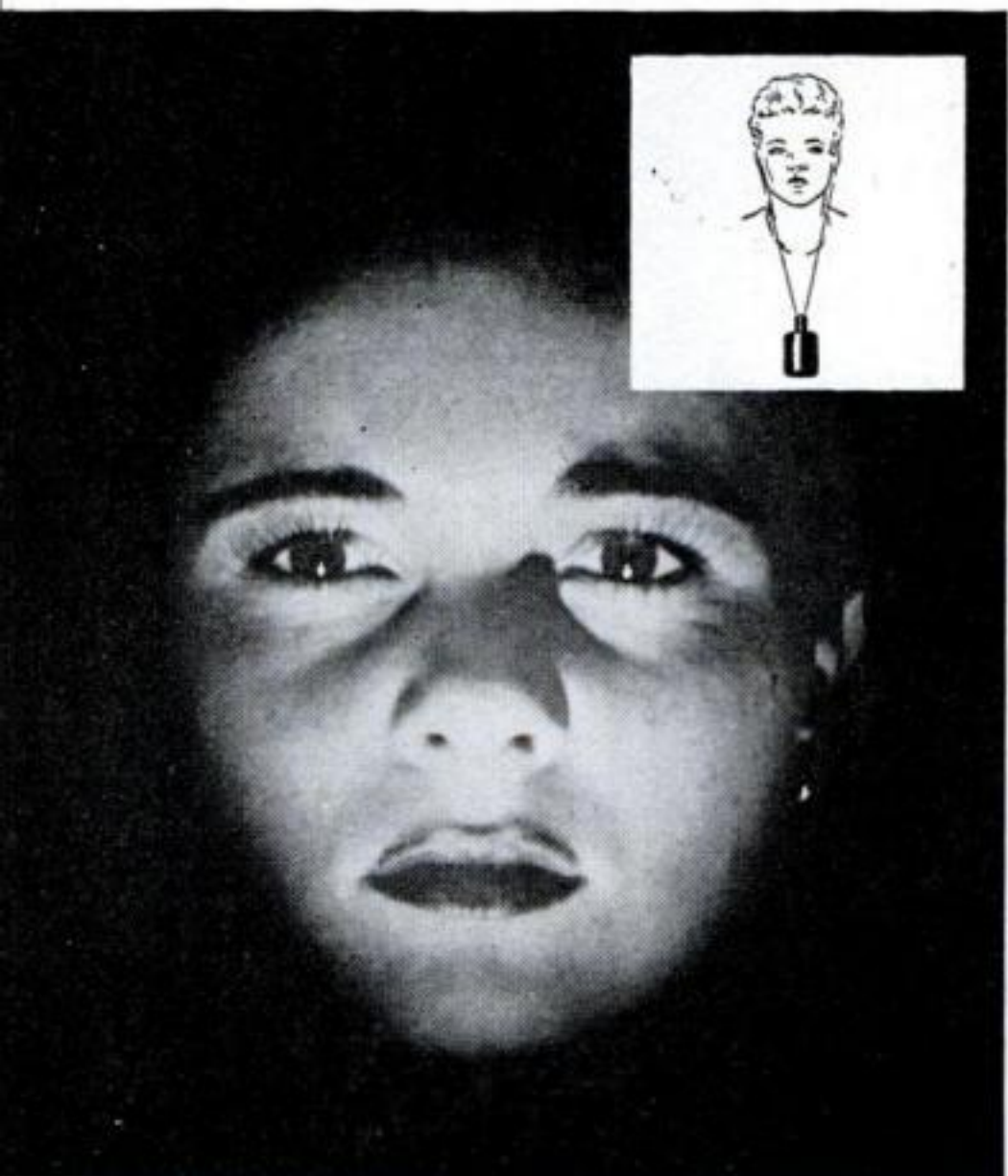




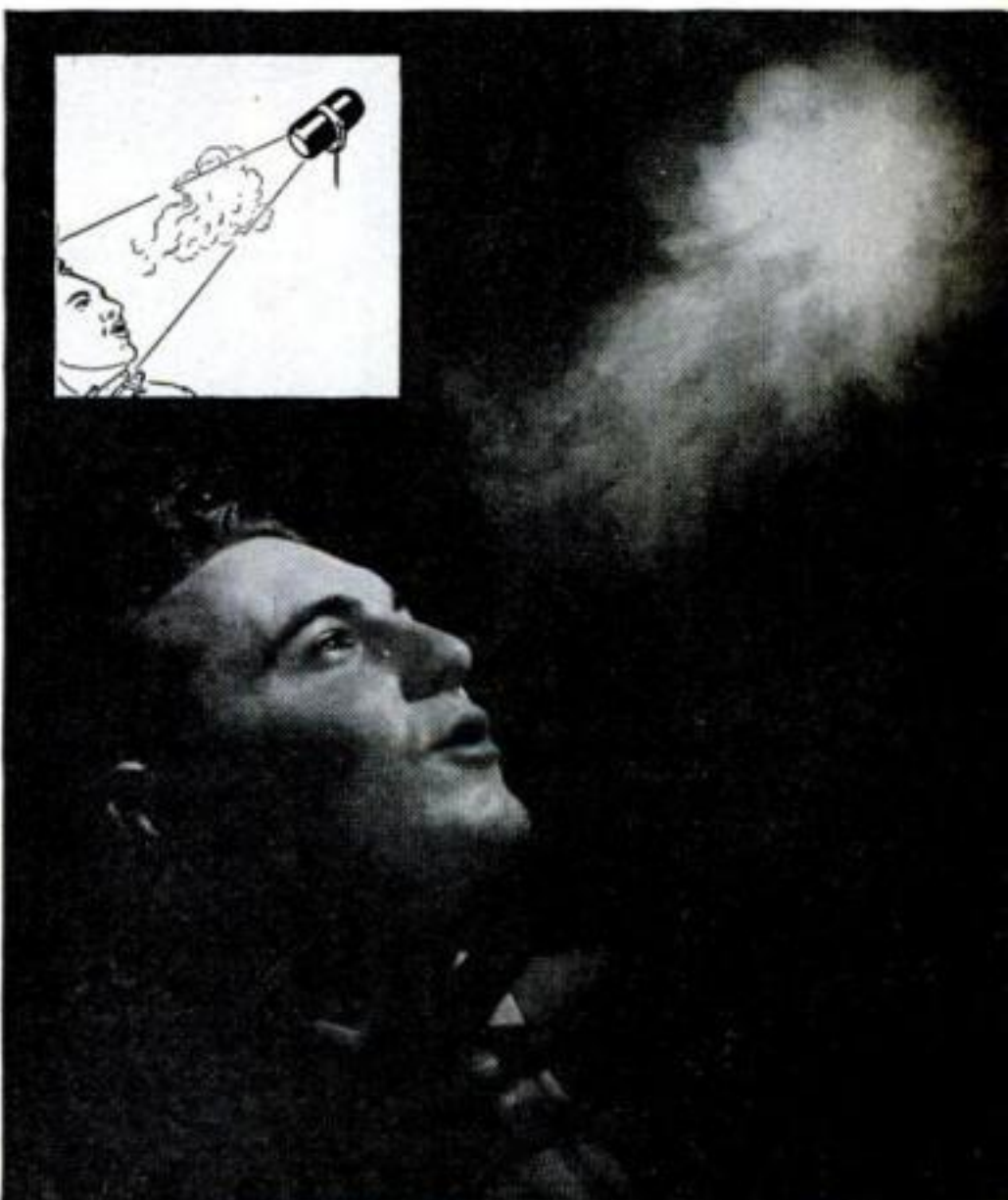
Dramatic shadows help heighten the effect of some shots. The sketch shows location of spot.



A reflector photoflood, placed high, illuminates the upturned face of this young pilot.



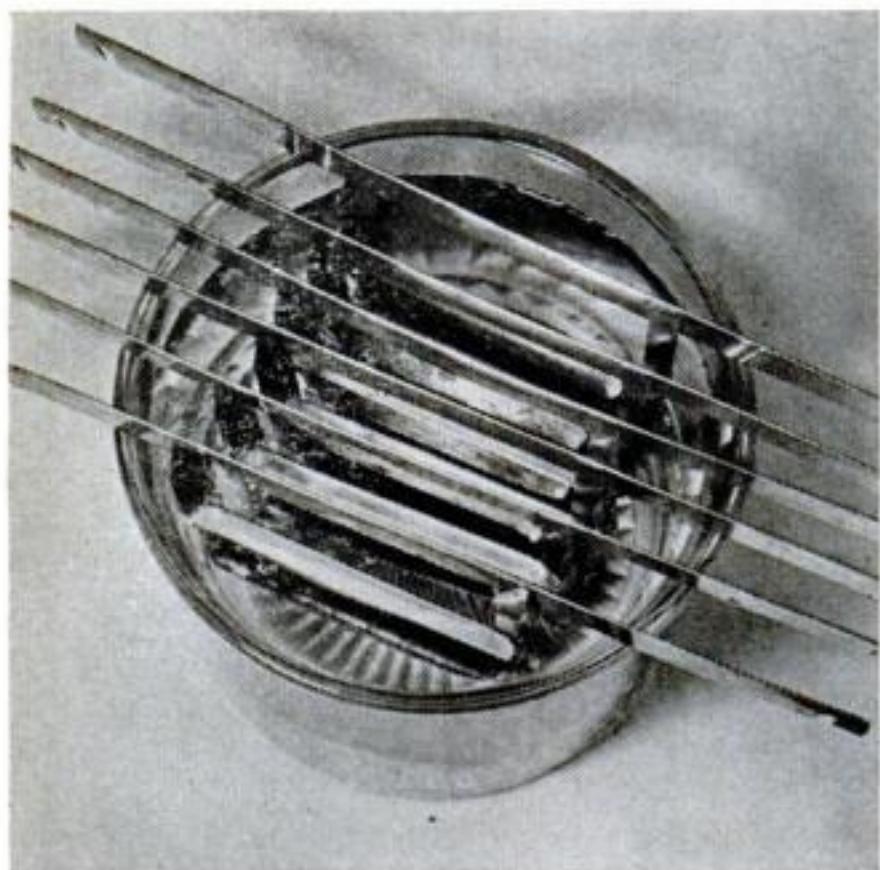
A narrow beam of light from a snooted spot placed below the camera was used for this one.



Many unusual effects are possible. Here, the light hits both the model and a puff of smoke.



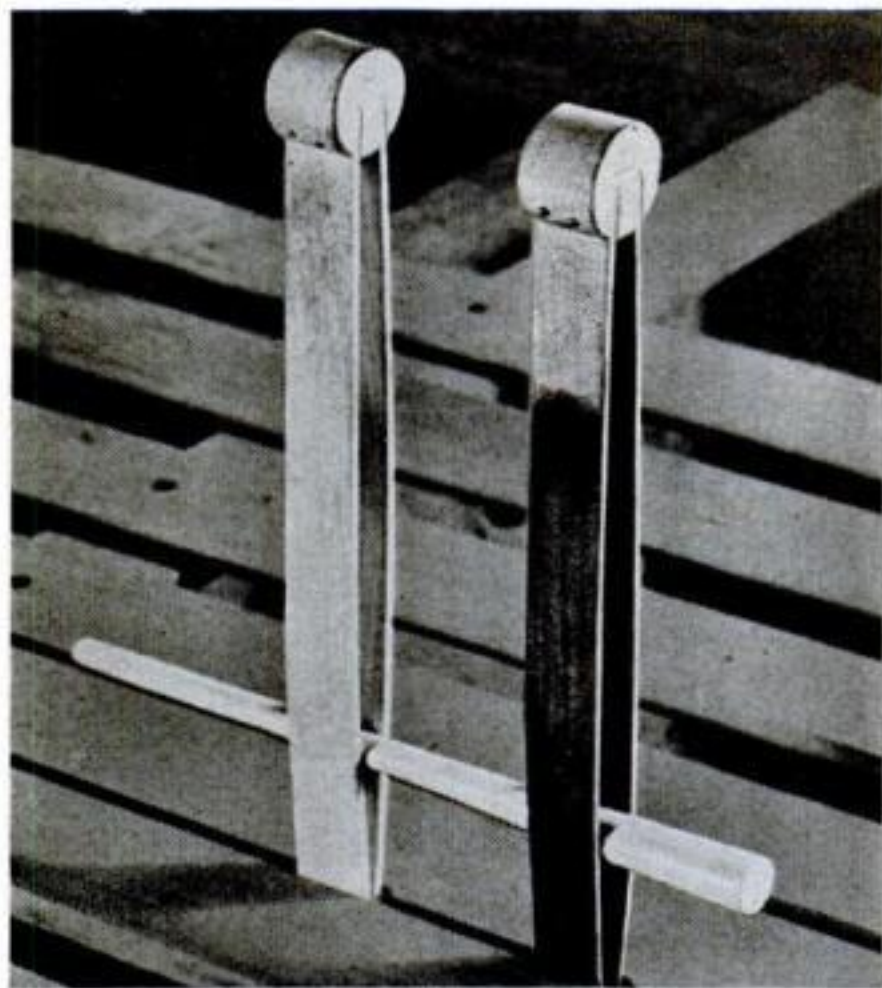
PHOTO IDEAS AND EQUIPMENT



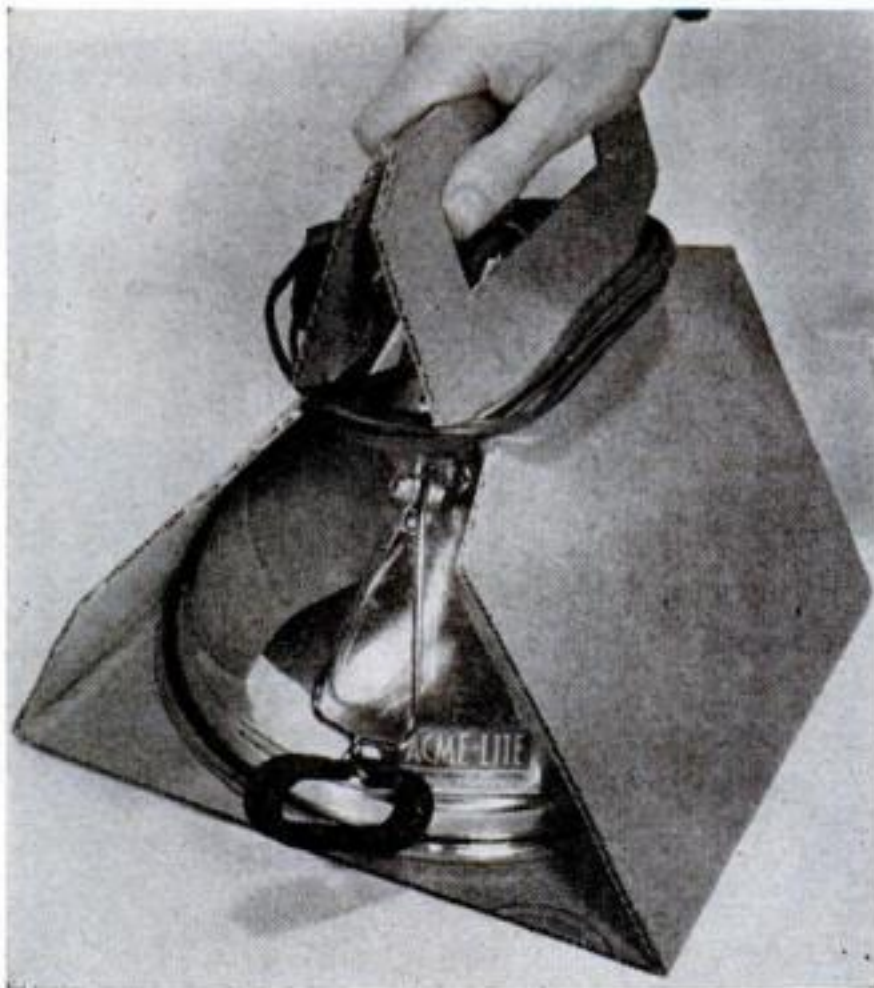
Bowl Is Developing Aid. A quart-size glass ice-cube bowl is a handy darkroom accessory. Accommodating half a dozen $2\frac{1}{4}$ " by $3\frac{3}{4}$ " hangers, it may be substituted for a cut-film tank in all developing steps. It also



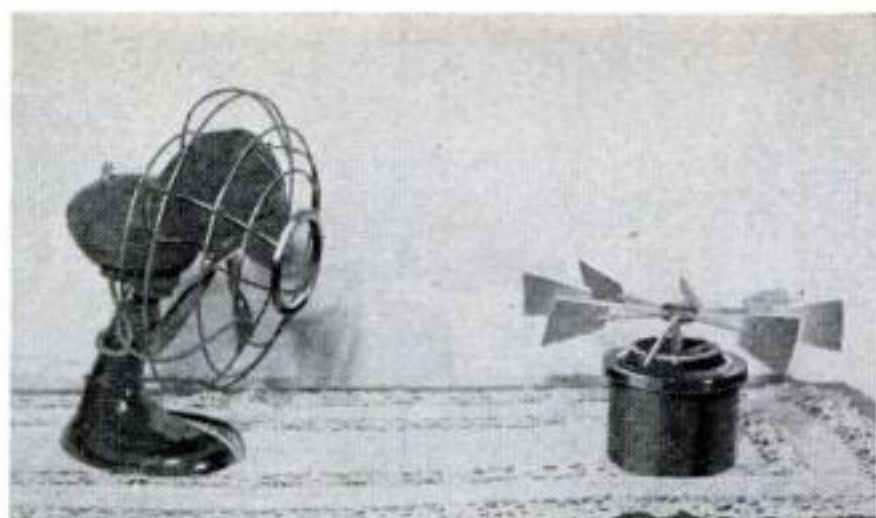
enables me to increase the effectiveness of my roll-film tank. While one reel of film is washing, a replacement reel can be loaded and development begun.—*Jack Wilson, San Pedro, Calif.*



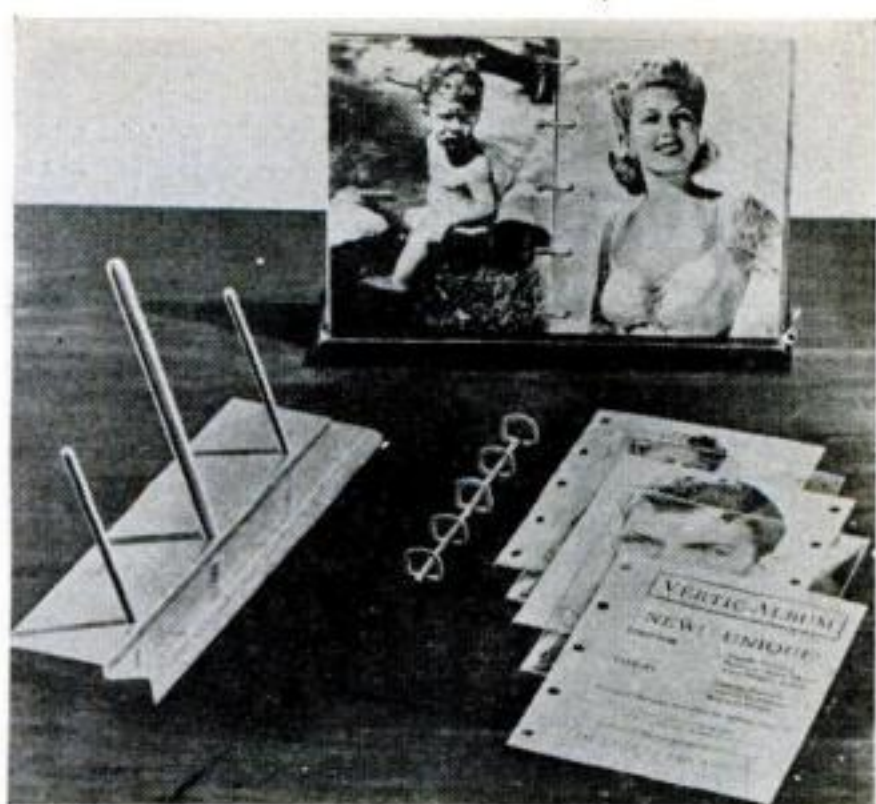
Tongs Strengthened. The holding power of wood print tongs can be improved by drying them with the tips inserted in a crack, and a stirring rod or pencil wedged between the prongs. When dry, the tongs will be bowed sufficiently to grip prints better.—*Glenn A. Wagner, Delmar, N. Y.*



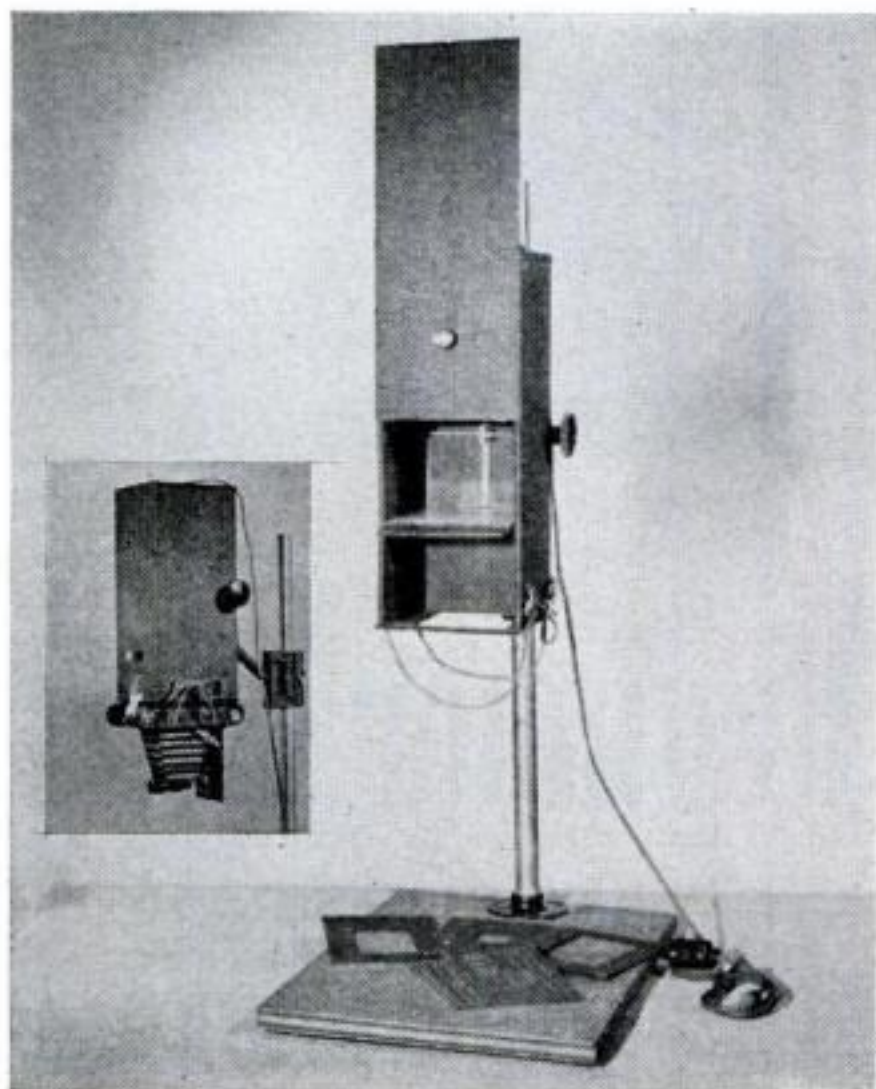
Carrier Made for Reflector. Heavy cardboard cut and bent like this will enable you to carry a reflector with ease. Cut the center square 2" larger than the reflector diameter, cut holes in the ends, bend up against the reflector, and loop the cord around.—*Henry Hanscom, Elmhurst, Ill.*



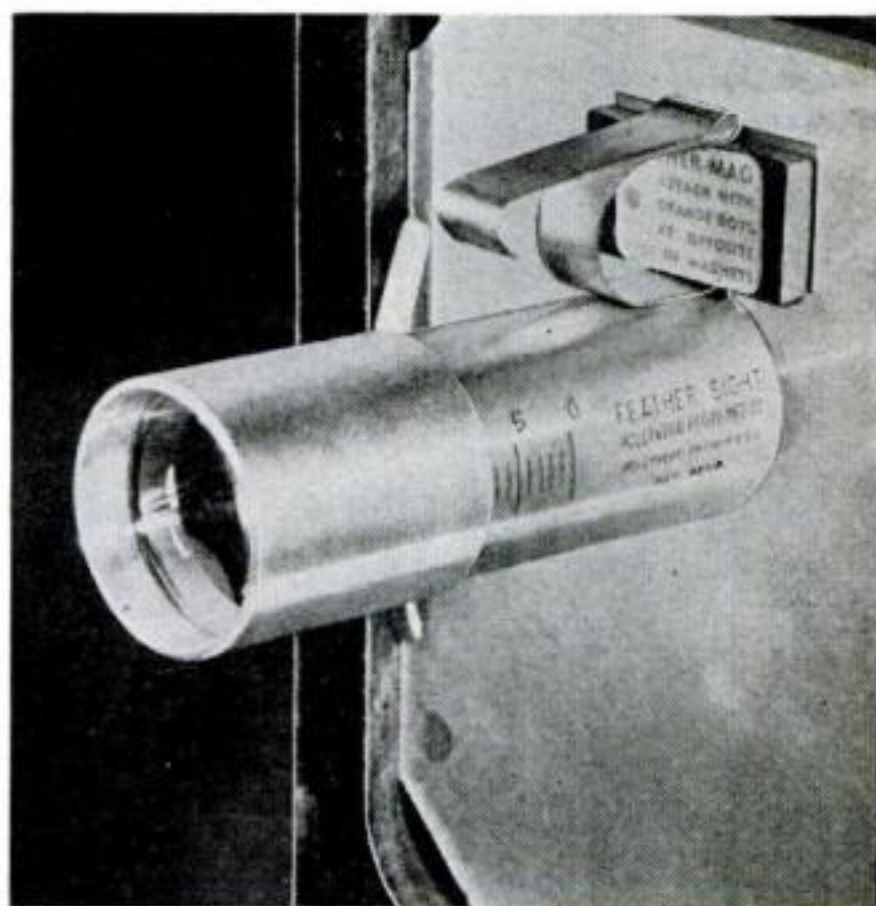
It's a Breeze. A little windmill and an electric fan do the agitating for me when I use my roll-film developing tank. Cut from light cardboard, the windmill blades were glued at an angle into the outer ends of dowels attached to a central hub, and a wood shaft was pressed firmly into the reel shaft. Speed of rotation may be adjusted by varying the distance from fan to tank.—*Burton Byler, Melrose Park, Pa.*



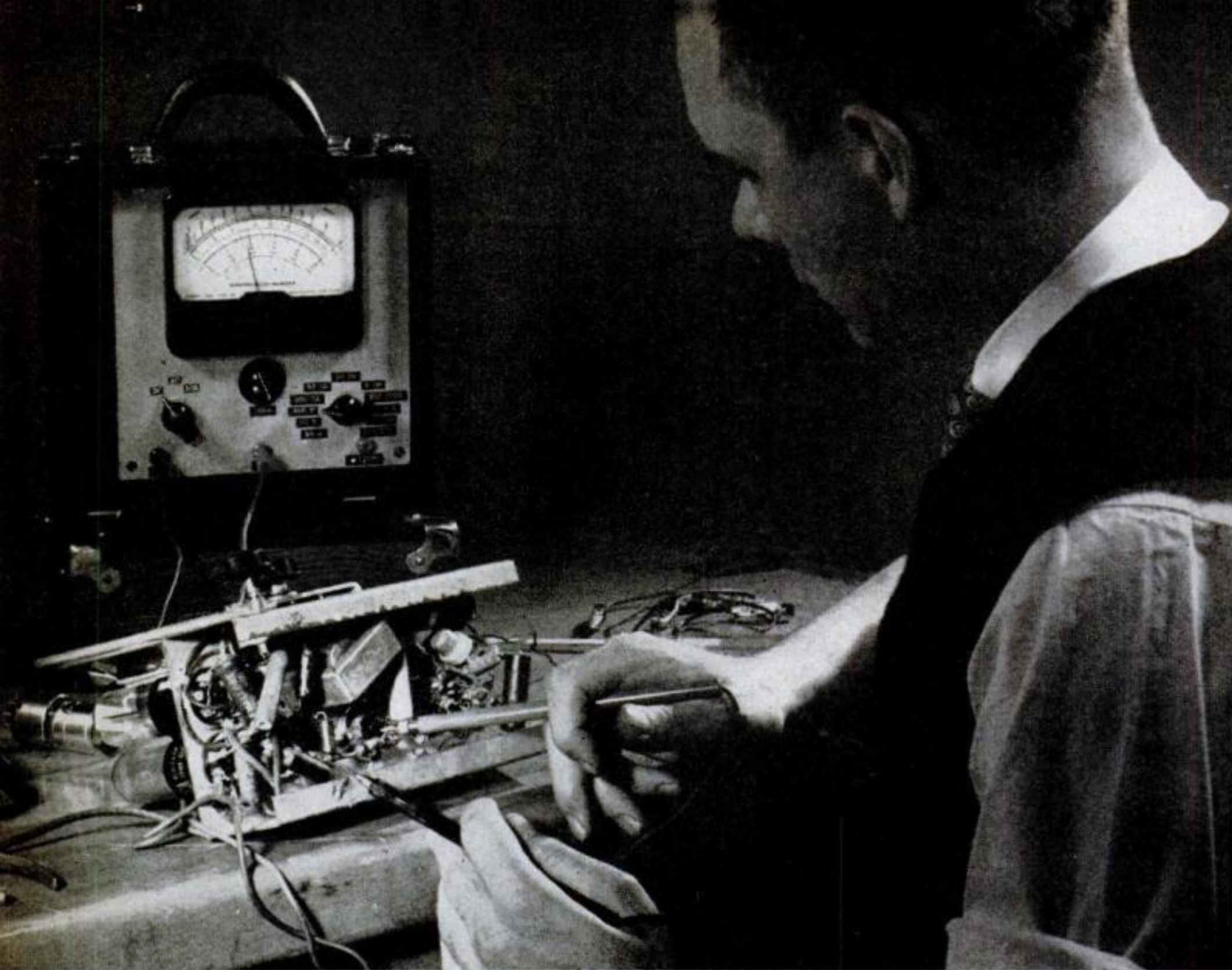
Stand Supports Album. A display stand is provided with a new album marketed by Develco Products, of Norwalk, Conn. Five clear-plastic envelopes accommodate ten 5" by 7" photos back to back or a larger number of smaller ones mounted on 5" by 7" sheets. The ring holder slips over the center rod on the stand.



Enlarger Uses Camera. In an enlarger offered by Engineered Products Company of Cincinnati, focusing is accomplished by moving the negative rather than a lens. This makes it possible to use any camera with the enlarger, even one of fixed focus, if the back is removable or opens 180 deg. Negatives up to 4 $\frac{1}{2}$ " by 5 $\frac{1}{2}$ " are placed in the carrier by sliding the front of the lamp housing upward. A knob racks the carrier up and down to focus. The enlarger retails for approximately \$20.



Magnets Hold Focusing Aid. Two permanent magnets, one placed inside the ground glass, keep this focusing device in any desired position on the glass. A product of the Hollywood Photo Manufacturing Co., Hollywood, Calif., it consists of a four-power magnifying lens mounted in a telescoping aluminum tube. Since practically all back light is excluded, the device gives sharp focus without a cloth. A scale on one side allows you to reset the tube at a previously determined focus.



A voltmeter check of a receiver is the most efficient method of locating causes of trouble.

Completing the Beginner's Set

Here are further pointers on wiring, aligning, and checking a superhet that anyone can build.

By a High-School Shop Teacher

ONCE you get to know your way around radio you'll find that there are only two things you really need to complete any building project: a schematic diagram and a parts list. Photographs, description, and pictorial diagrams are "extras" like a radio and heater in a car. You can get where you're going without them, but they sometimes make the trip more comfortable.

Since all the essential information was

given in the first part of this article last month, you may have completed your five-tube superhet. Assuming that you have, and that it's working to your complete satisfaction, you need only file this installment for future reference. Radios do break down, and when they do it is comforting to know the most likely places to look for trouble.

If on the other hand you have waited to become thoroughly familiar with the project before heating up your soldering iron, you may be interested in more construction tips.

Most connections in a radio circuit end up at the tube sockets, so it seems reasonable—for the beginner at least—to start with the five octal sockets and make them the heart

of the wiring schedule. It may be helpful to indicate the manner in which connections are made to a typical socket. Let's take the 12A8, because it is probably the most difficult of the lot.

Remember that pin numbers are counted clockwise from the keyway in the center when you are looking at the underside of the socket. Prong 1 is a shield pin and it can either be left alone or grounded to a mounting screw and used as a lug for nearby ground leads.

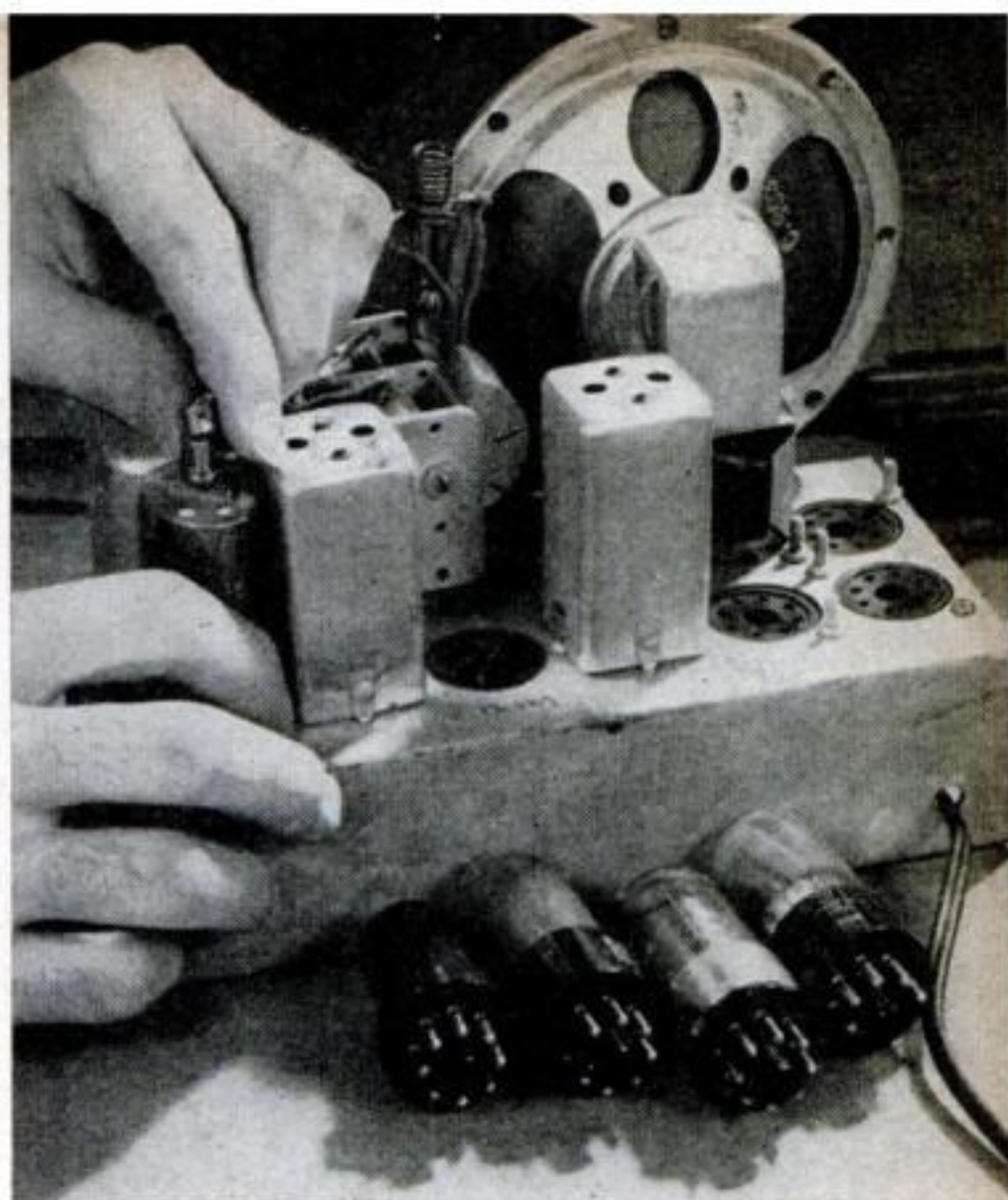
Pins 2 and 7 are the filament connections. These are shown separately in the schematic diagram. Solder a piece of yellow wire to one of these—say pin 2—but don't make any connection to the other one. If you follow the same system with the remaining tubes you will simply connect the yellow lead from pin 2 of the 12SK7 to pin 7 of the 12A8 after all sockets are in place.

The oscillator coil (L2) is a rather small unit with four lugs. Solder the plate lug (usually indicated by a blue dot) directly to prong 6.

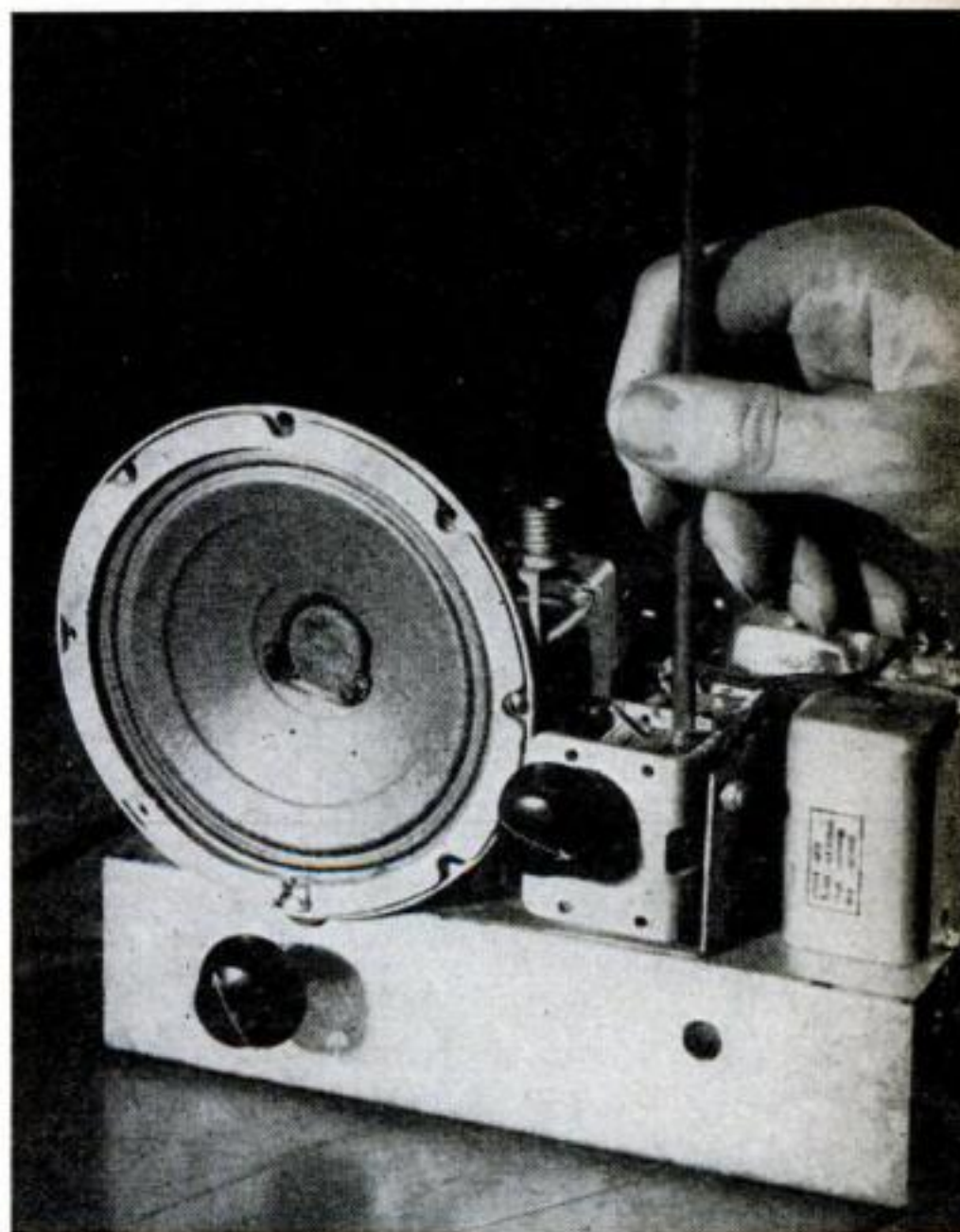
The critical 50,000-ohm resistor, R1, is connected across pins 5 and 8. Try to get a very small resistor that will fit neatly between these pins and be entirely out of the way. Hook it in place, but don't flow in the solder until you have made the remaining connections to these pins. You can usually get a better joint when you avoid cluttering it up with too much solder. In the case of prong 8 the additional connection is only a ground lead; pin 5 isn't finished until you have brought to it one end of R2 (a 15-meg. resistor) and of C3 (a .0001-mfd. mica condenser). The other end of C3 can be soldered to the grid (green) lug of the oscillator coil at the same time. One end of a 20,000-ohm resistor (R3) goes to pin 4. Hold off the solder on this one, too, as another connection will be made later.

All these connections can be made before the 12A8 socket is attached to the chassis. After the socket is in you will be able to bring the plate (blue) lead of IF1 (the input IF transformer) to pin 3; the B-plus (red) wire from the same transformer to pin 4; and the lead from filament pin 2 of the 12SK7 to prong 7. The connection to the grid cap at the top of the tube consists of a short jumper from the RF section of the variable condenser, C2.

For all of the tubes except the 35Z5 rectifier, the filament connections may be reversed without causing any harm. But on



Tubes are fragile, so install them only after all the wiring is completed. The jumper lead from the RF section of C2 must be clipped to the grid cap of the 12A8 mixer tube.



An alignment tool should be used for adjusting trimmers. Being nonmetallic, it can't short B-plus to ground. It also keeps hand capacitance from changing any of the circuit constants.

the 35Z5 it makes a great deal of difference. If the line lead is brought to pin 7 instead of pin 2, the No. 47 pilot light will burn out. There will also be a voltage drop of about 35 volts due to the resistance of the filament. This will be reflected in decreased B-plus and plate voltages in other parts of the circuit. Make absolutely certain, therefore, that the live line lead comes to prong 2 of the rectifier.

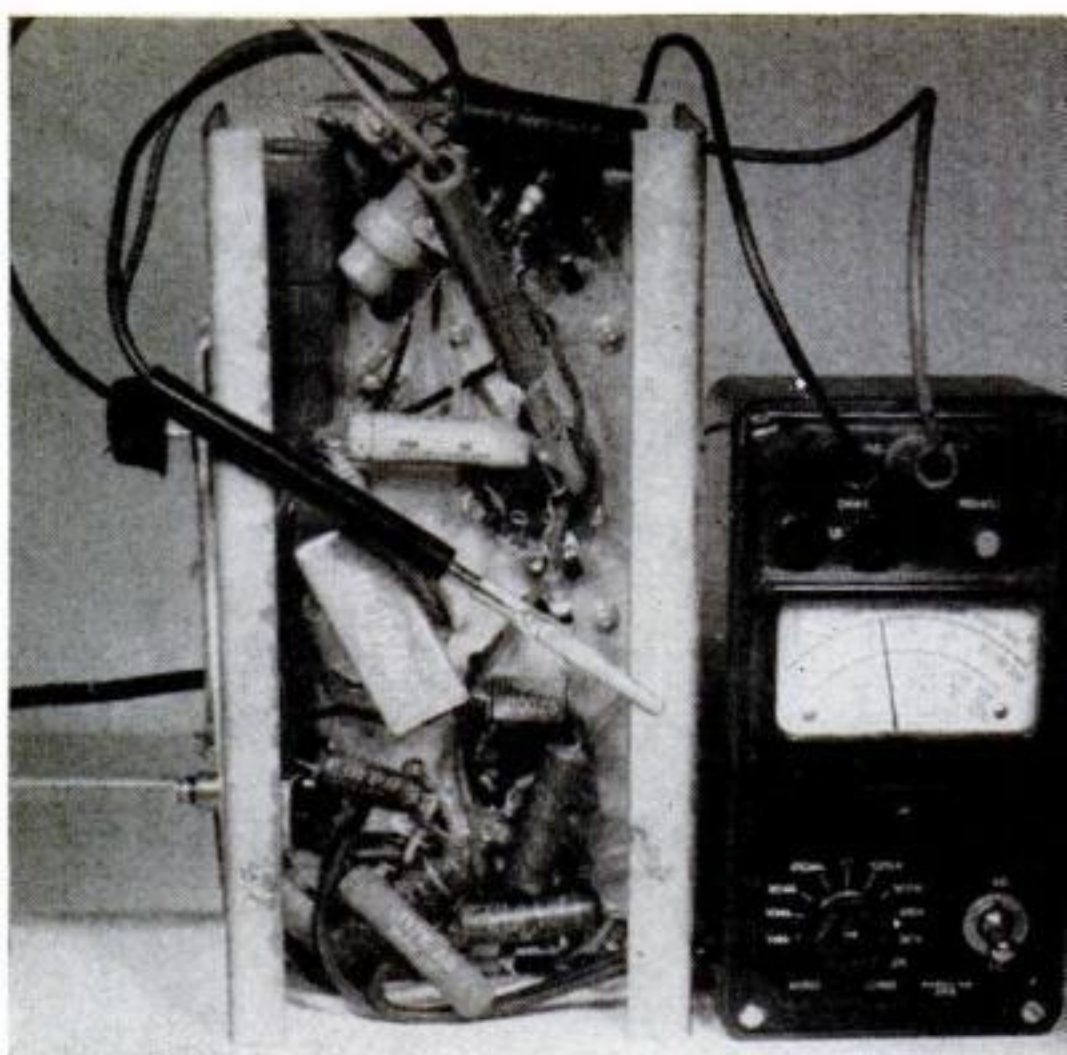
With pin 8 of the 12SQ7 and one leg of the switch grounded, the filament circuit is complete. A break anywhere in this line will kill the operation of the set completely. That's the reason servicemen always suspect a tube-filament burnout first whenever an AC-DC set fails to light up.

Using the chassis as the power-line ground connection has some desirable shielding effect, but it is important to note that it also produces a "hot" chassis. *Never* let the chassis come in contact with a radiator, water pipe, or any other metal that leads to an earth ground, and don't touch it yourself when the line plug is connected. Felt or rubber-covered bumper feet in the bottom of the cabinet, and plastic or similar insulating knobs on the volume-control and tuning-condenser shafts are desirable. The .00025-mfd. mica condenser, C1, is inserted in the circuit principally to guard against accidental shorts through the antenna. A built-in loop could be used instead of the antenna coil, L1. In this case, simply omit C1 and L1 and wire in the loop in place of the antenna-coil secondary—i.e., between the points marked "C-" and "Grid." All grounds shown in the diagram are to the chassis itself. *Never* use an external ground.

For systematic service checking—and even for effective building—one of the most useful instruments you can have is a multitester or AC-DC volt-ohm-milliammeter. This will measure the ohmic value of most of the resistors and coils (depending on the meter's range) and will enable you to check voltages at any point in the set.

If you have the use of a meter, it is a good idea to take as many readings as possible on the individual parts before you actually wire them into the circuit. This can frequently give you a clue to trouble in a completed set.

In taking voltage readings it is considered good practice to clip the negative voltmeter terminal to the chassis or ground, then touch the positive lead to the various tube pins. Voltages exist at many other points, but

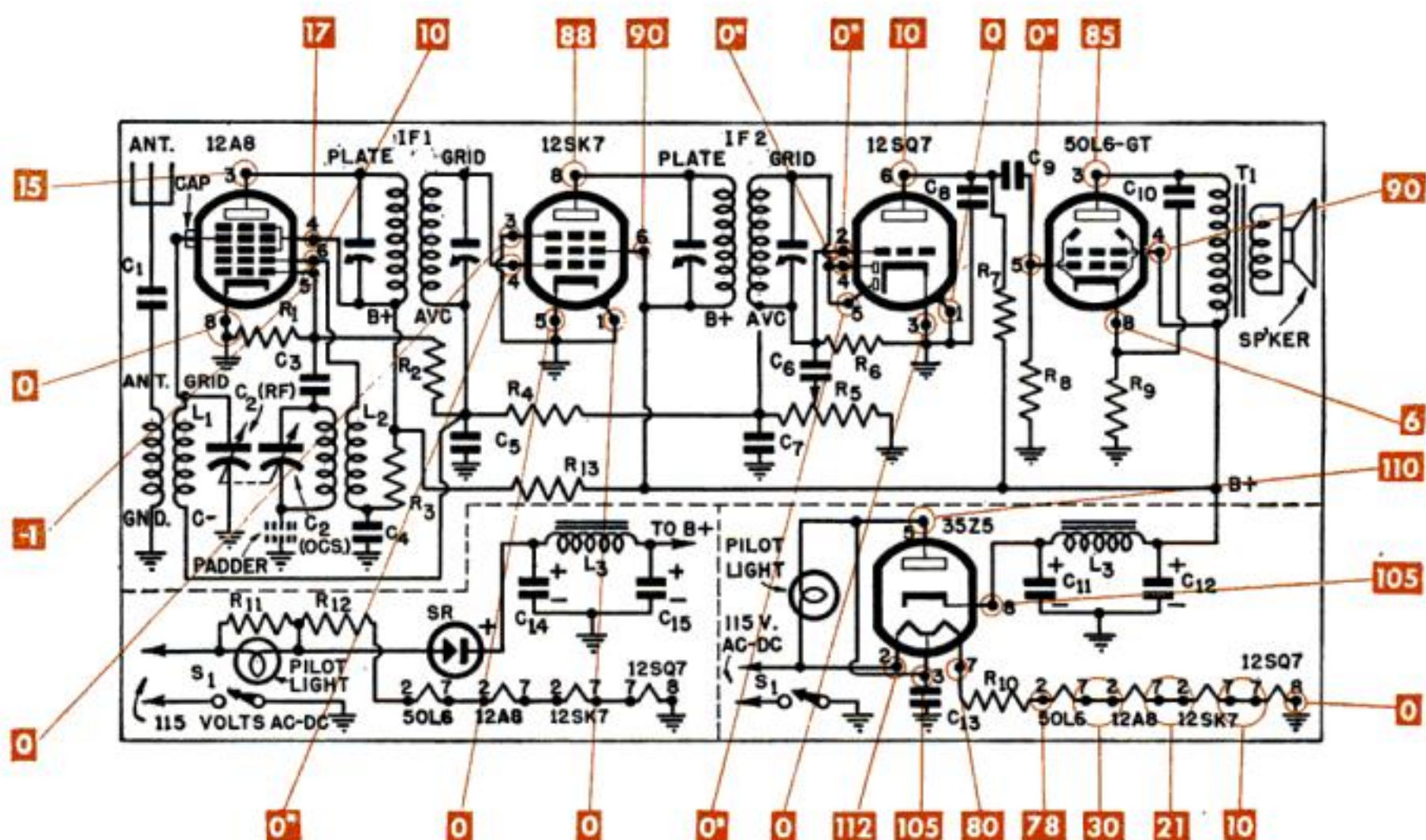


Clip the negative prod of a voltmeter to the chassis; touch each tube pin with the other.

what you can't read directly by this method you can usually get by subtraction. For example, if you subtract the voltage at pin 3 of the 12A8 from that at pin 4, you have the voltage drop across the primary of IF1.

As an aid to ready checking, a table of voltage readings is given on page 223. These were taken with a 1,000-ohm-per-volt meter. An instrument of greater or lesser sensitivity will give different readings in many cases because of the "loading" effect of a meter on a circuit. Greatest accuracy is obtained with a vacuum-tube voltmeter because of its high internal resistance. If you have one of these instruments you will probably be able to observe a slight negative voltage at the points marked in the table 0.* On the low-resistance meters used in these tests, no needle deflection was noted. Values shown in brown on the table represent filament voltages; when the set is used on AC, these will have to be read on the AC meter scale. Above the table is a reprint of the schematic diagram with each voltage related to its proper pin.

Your readings may vary slightly, and if they do, don't worry about it. Remember that voltage checks are used primarily as guides to trouble *when trouble appears*. To scramble a metaphor, the proof of the pudding is in the listening. If the set sounds good, you can forget about almost everything else. If it doesn't, or if it fails to operate entirely, an incorrect voltage may give



Taking a reading from each of these points to ground will show whether voltages are present

at the places where they should be and whether they are large enough to do their job properly.

you the clue you need to find the trouble.

The big bugaboo in superhets—and the thing that has made many experts feel that the circuit is too complicated for the beginner—is alignment. This consists of integrating the various circuits so that they are in harmony with each other. Fortunately it is rarely necessary to do the job entirely on your own. Manufacturers generally align their IF transformers pretty well at the factory. You only have to make small adjustments. Whatever you do, *don't tamper with the trimmers on these transformers until the set is finished.*

Automatic volume control—AVC—uses part of the rectified signal present at the detector to vary the grid bias on the 12SK7 and 12A8. When a strong signal comes through, the amount of voltage available for biasing goes up and this automatically decreases the amplification of the tube. On a weak signal the reverse occurs. Now, for aligning you want to know when you are getting a station at maximum strength, and this automatic compensation for weak signals would only throw you off. The first step, then, is to ground the AVC by running a jumper from the black lead of the input IF transformer to ground.

Set the manual volume control (R5) at maximum, and tune in the strongest local station. Working back from the output end, and using a fiber wand or other insulated

TUBE	PRONG							
	1	2	3	4	5	6	7	8
12A8	0	30	15	17	-1	10	21	0
12SK7	0	21	0	0*	0	90	10	88
12SQ7	0	0*	0	0*	0*	10	10	0
50L6	NC	78	85	90	0*	NC	30	6
35Z5	NC	112	105	NC	110	NC	80	105

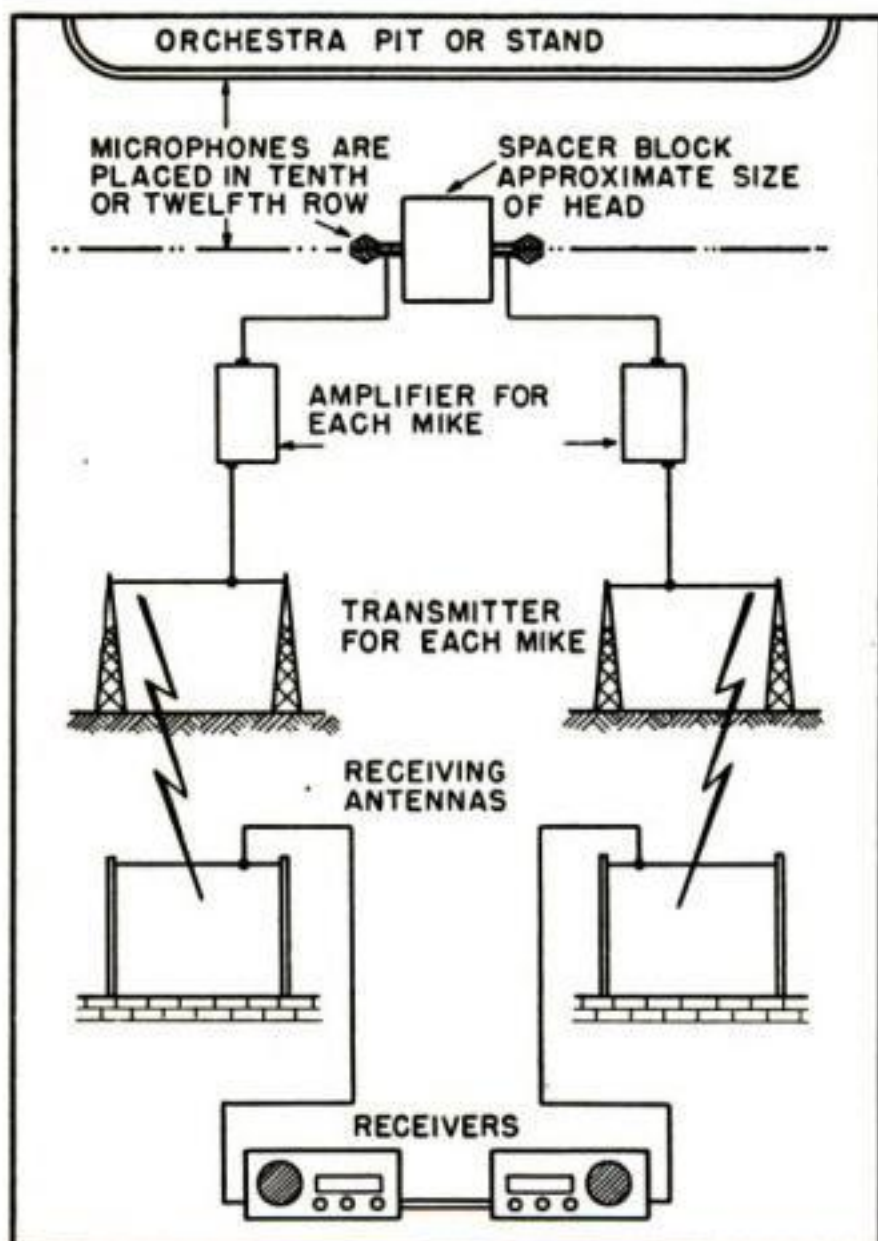
For a negative reading, polarity of the voltmeter terminals must be reversed. A vacuum-tube voltmeter should read slightly negative at the points marked with an asterisk (*).

screwdriver, adjust the trimmers for maximum output in the following order: the secondary of IF2, then the primary; the secondary of IF1, and again the primary. Now tune in a station somewhere around 1400 kc—the variable-condenser plates are almost fully open at this point—and adjust the oscillator section of the tuning condenser, and, last, the RF section of C2. Bear in mind that it is seldom necessary to make much of an adjustment in the IF trimmers. Don't touch them at all until you have tuned in a station.

Should the signal become quite loud during the adjustment, it is advisable to get a weaker station. When you have the high end of the band lined up, tune in a station at the other end and make whatever slight adjustments may still be necessary. **END**

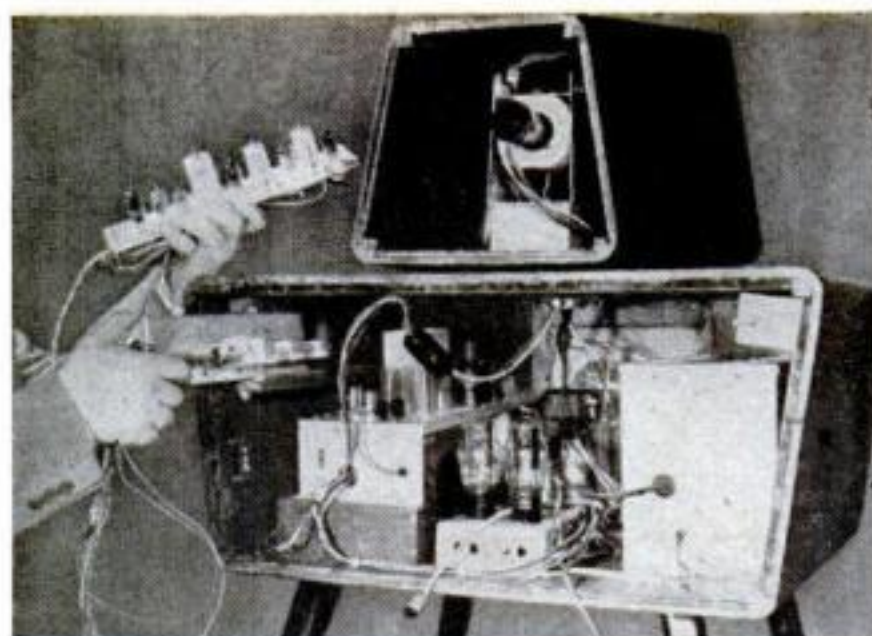


NEWS IN ELECTRONICS



Transmitter Has Two Ears. One of the major differences between live music and a radio reproduction of it is that radio has only one ear. Binaural (two-ear) hearing is what enables you to distinguish the direction from which sound comes. Experiments in "stereophonic" or two-transmitter broadcasting, recently conducted in Holland, are said to offer promise of greater realism in radio reproduction.

Comparable to stereoscopic or three-dimensional photography, this system uses two microphones to feed separate transmitters operating on different frequencies. Two receivers reproduce the broadcasts in the same relation as heard by the two "ears" in the concert hall.



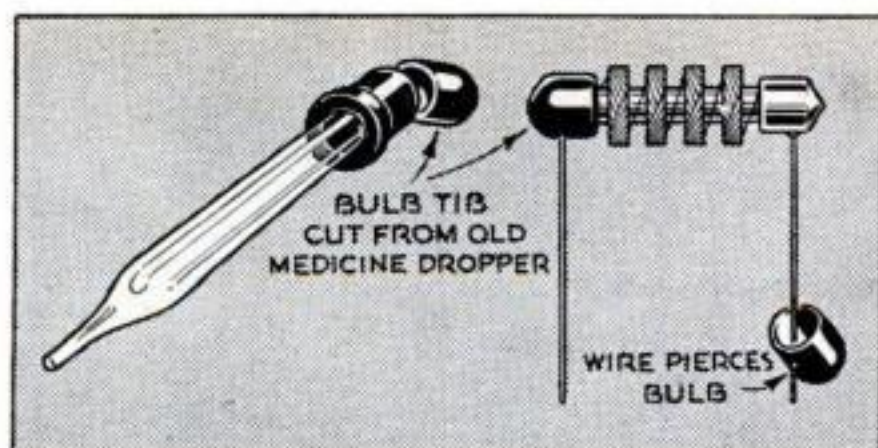
Chassis Plugs In. Fragile and bulky television receivers can't easily be carried to a service shop, so some manufacturers are building sets on multiple chassis. The model shown here has five. One or more of them can be quickly replaced by the serviceman. Defective units are repaired in the shop. Cleervue Television Corp., Brooklyn, N. Y., is the maker. The picture tube, housed separately, can be swiveled 180-deg. for easy looking.



Printed circuits combining 45 parts on one chassis are said to make the new Beltone Mono-Pac® the smallest hearing aid to date. The tiny electronic unit weighs less than 6 oz. and measures 2 3/16" by 3 3/8".



Unit Modernizes Tube Testers. The appearance of many new tube types—especially postwar miniatures—threatens thousands of old tube checkers with obsolescence. To meet the problem, Radio City Products Company, Inc., New York, has introduced two units that can be plugged into a socket on the old tester. New tubes are tested in the adapter.

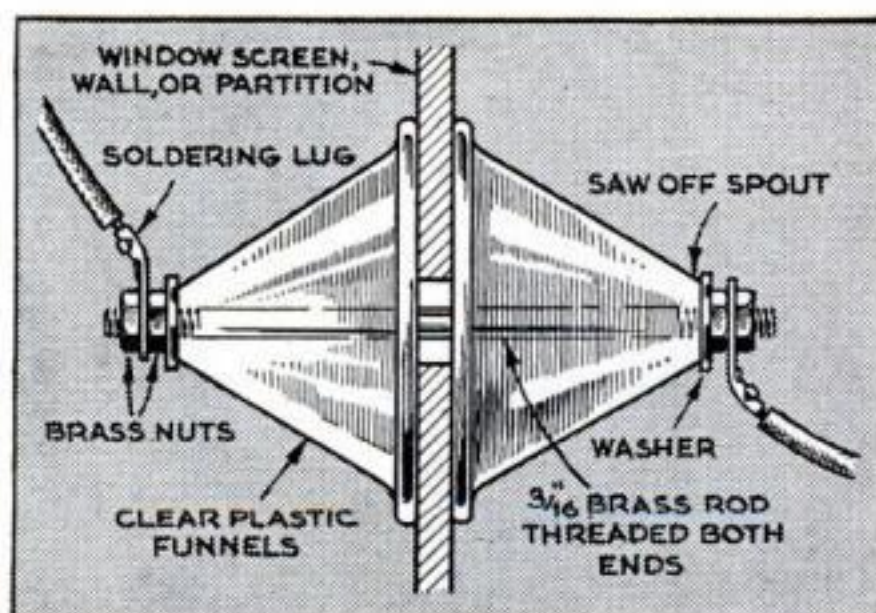


Rubber Tips Insulate Chokes

WHEN crowding radio parts close together to make a compact job, here's a method for protecting the bare metal ends of an RF choke against accidental contacts. For each end, cut the rubber tip from an old medicine dropper and place it over the end as shown.—*Alfred H. Fortier, Orono, Me.*

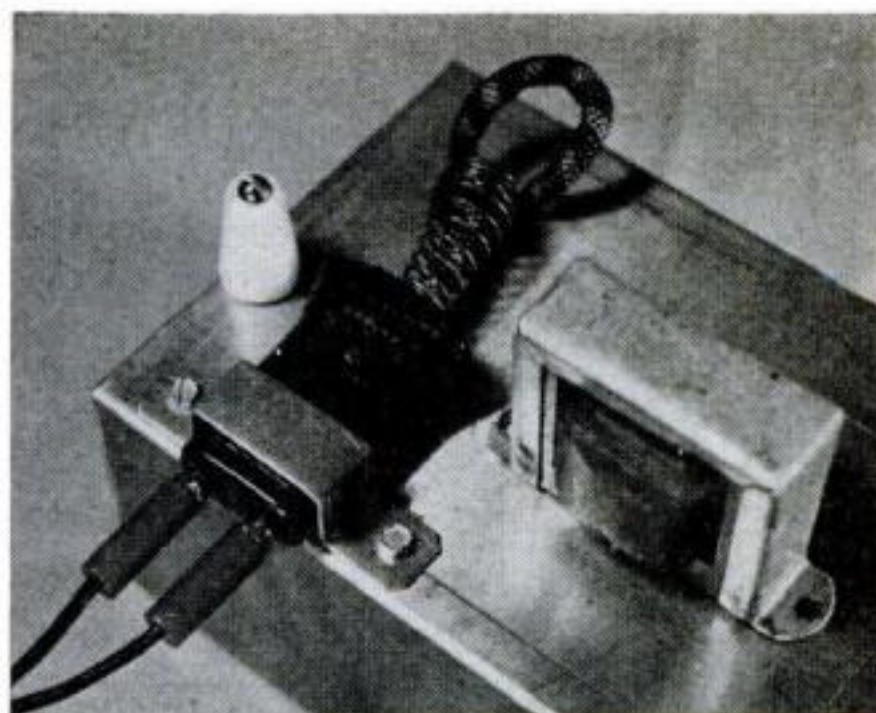
Vent Holes Prolong Tube Life

A FEW $\frac{1}{8}$ " holes drilled around the socket of the rectifier tube of a large receiver, amplifier, or transmitter will keep the tube cooler and thus help to increase its life. Other nearby components are also benefited because the increased air circulation carries away much of the damaging heat.—*D. J. Bachner, Jackson Heights, N. Y.*



Insulators Made From Funnel

I MADE some swell cone-type feed-through insulators from the small plastic funnels sold in dime stores. Comparable commercial insulators would have cost me a lot more. Two of the funnels, with the tips cut off, are used for each insulator as shown in the sketch above.—*Arthur Trauffer, Council Bluffs, Iowa.*



Iron Plug Is Phone Terminal

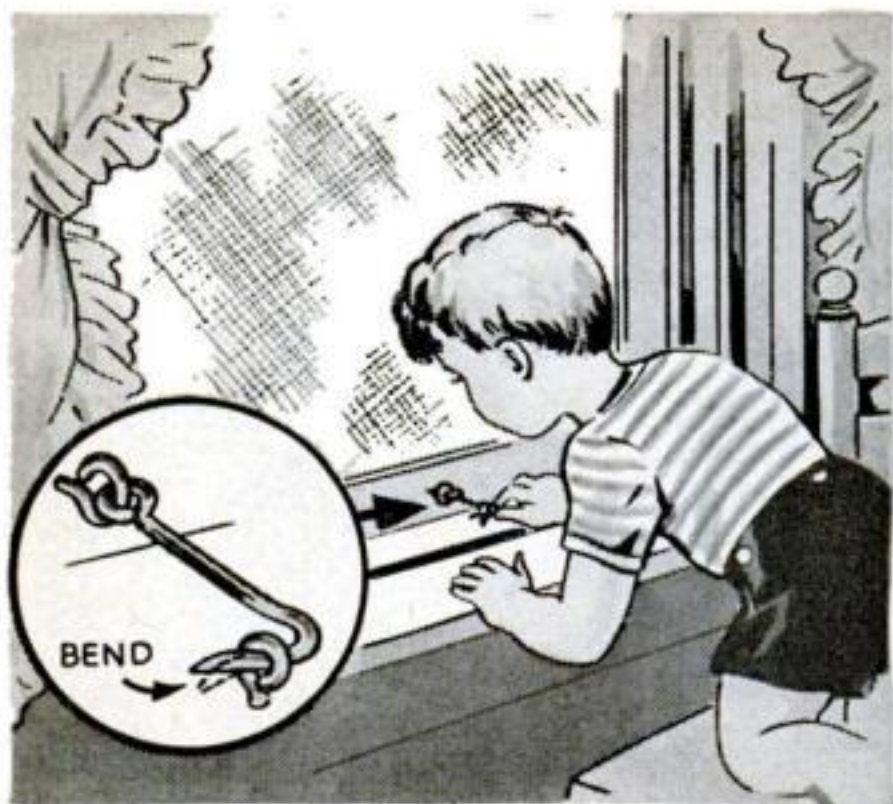
AN OLD electric-iron plug can be converted into a handy terminal for a mike or phono input or used for an output connection to speaker or phones. Its own cable can be brought under the chassis to the appropriate connections. Incoming leads are fitted with banana plugs, which are in most cases a good fit in the holes. Either bolts and nuts or self-tapping screws can be used to hold the clamp. Being built with heavy-duty insulation, the plugs can be attached directly to the chassis as shown.



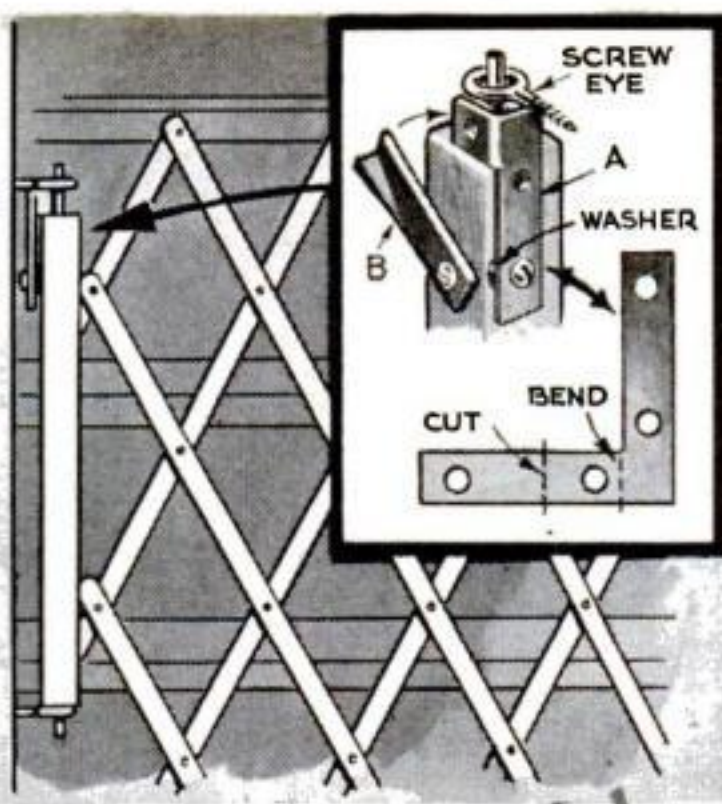
Pointer Filed on Plain Knob

IT is often convenient to have a reference point on the knob of a volume, tone, or other control so that a setting can be noted for future use. If you don't have a pointer knob on hand or want one that matches the others as closely as possible, you can convert an ordinary round knob to your purposes as shown. File two small flats on the rim, leaving a small portion between them. Then file this portion sharp to form the pointer.

A spot of paint or nail polish on the point will make it easier to read.



Screens and storm windows seem to invite tampering. Bend the hook as shown so it will resist his fingers but not yours.

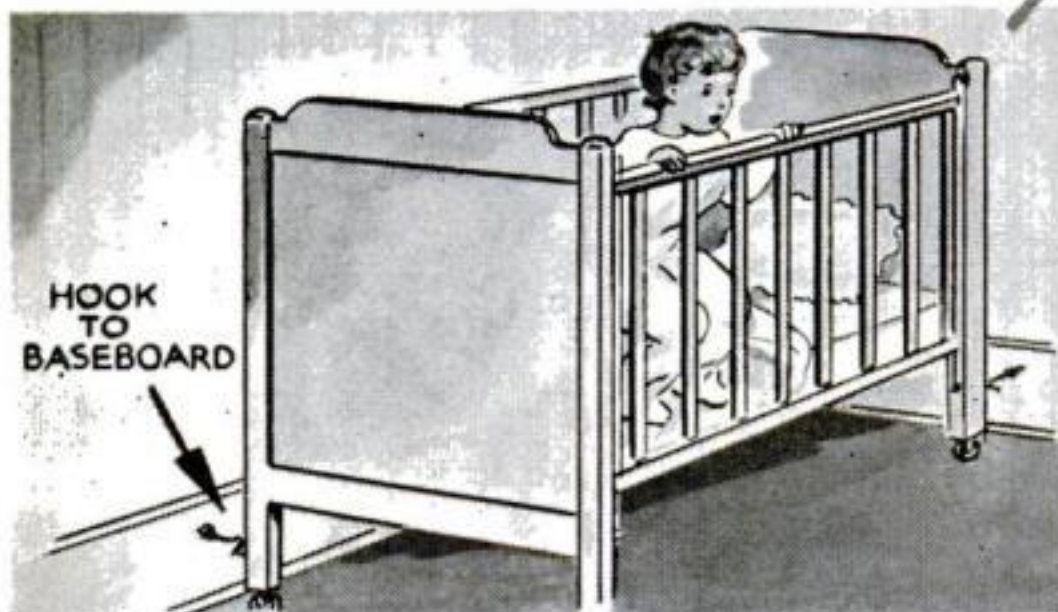
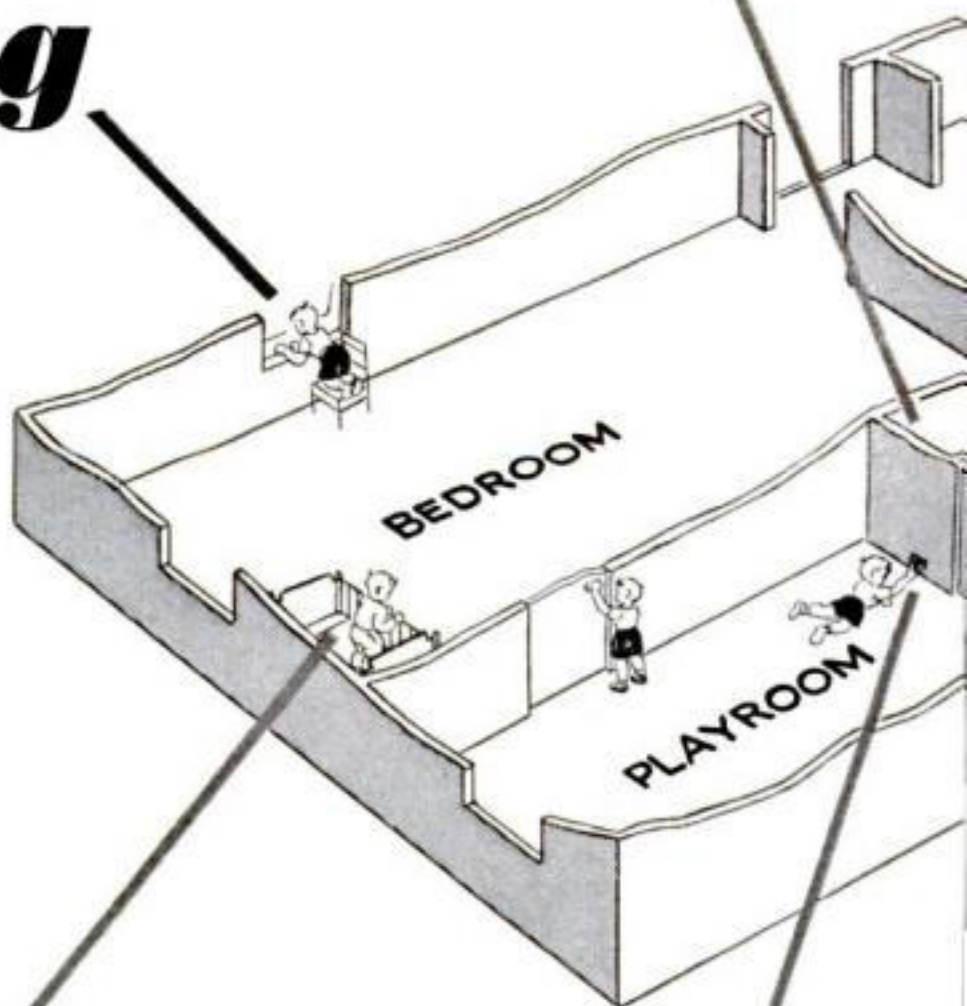


Headless screws enter screw eyes, the top one first, to lock this stair gate. Lever A is swung up, then B secures it.

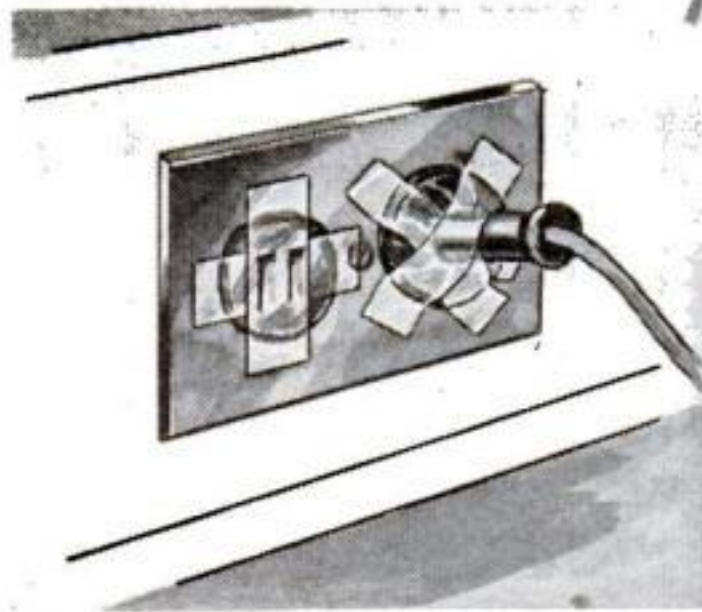
Babyproofing Your Home

"SAFE at home" may mean something in baseball, but anybody who thinks it applies to houses just hasn't lived with kids. You can trust any youngster to find a dozen danger spots in his own bedroom without half trying. If he's not probing electric outlets with a hairpin, he's probably planning the easiest way to fall out a window.

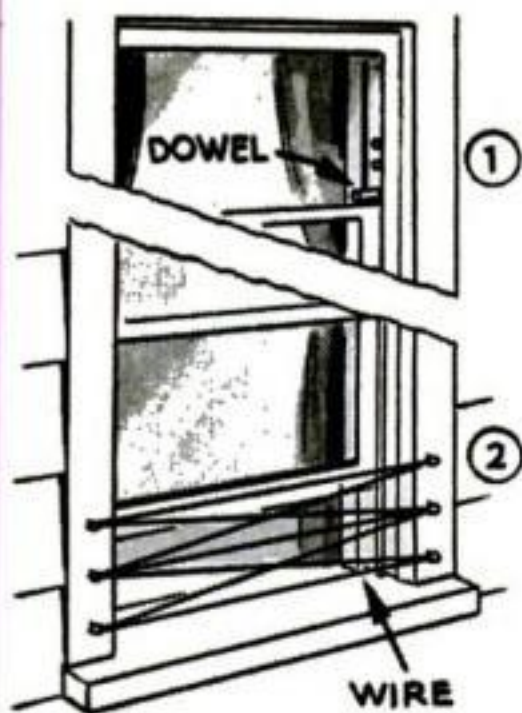
The only answer is vigilance plus an ounce or two of forehanded prevention. There's just no substitute for the first, but these simple ideas for countering some common hazards may stave off those gray hairs a while.



You can't stop him from jumping in his crib, but you can fix the crib so it won't block doors or tumble furniture.



Wall outlets are less dangerous when they're protected with cellulose tape.



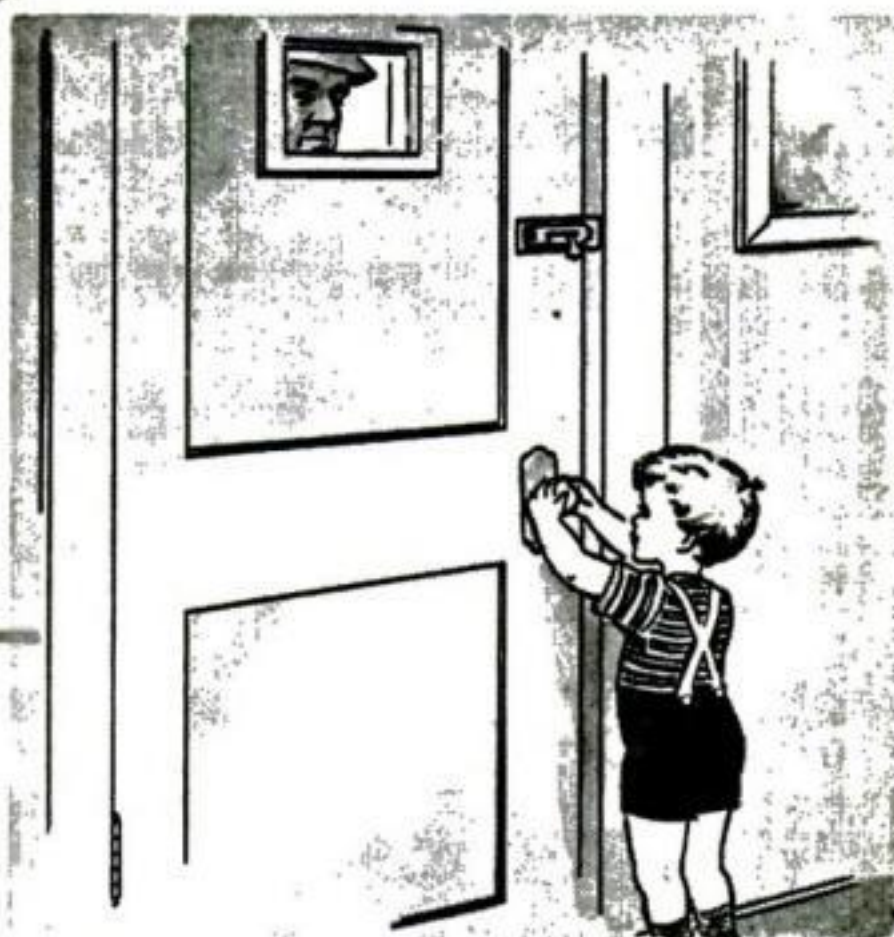
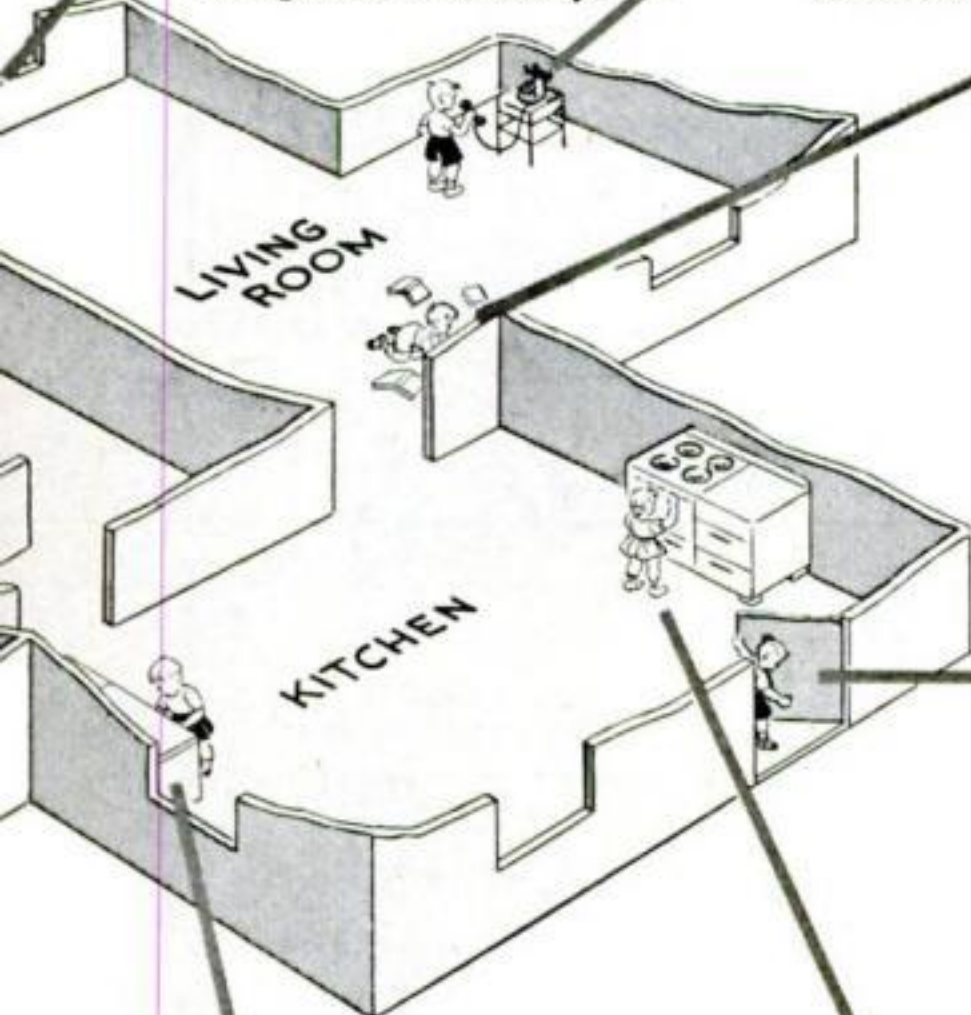
Dowel stops or looped wire allow windows to be opened with safety.



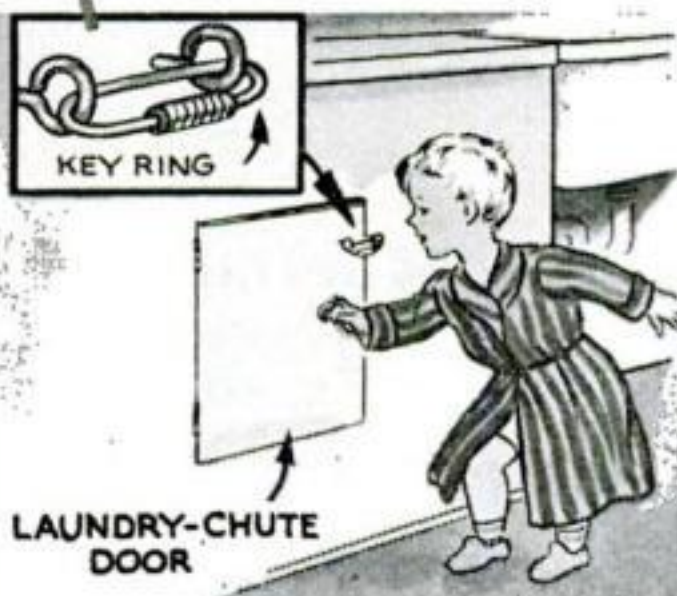
Receiver off the hook? A rubber band will keep the contact bar down anyway.



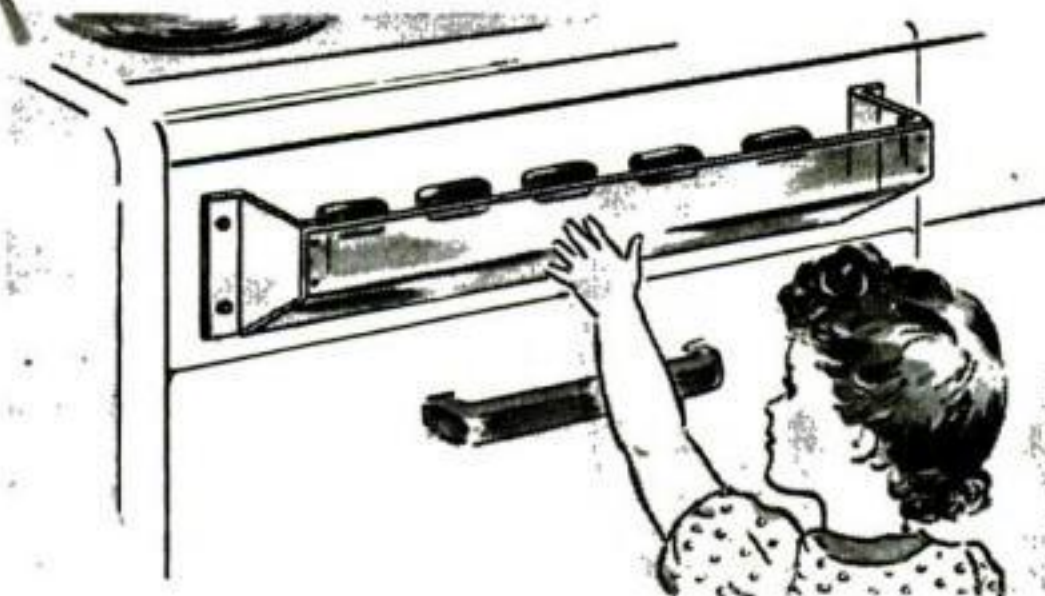
Books are fun to pull out. Wedge them in low shelves to thwart little bookworms.



A draw bolt placed out of his reach will keep him from opening doors while you're upstairs.



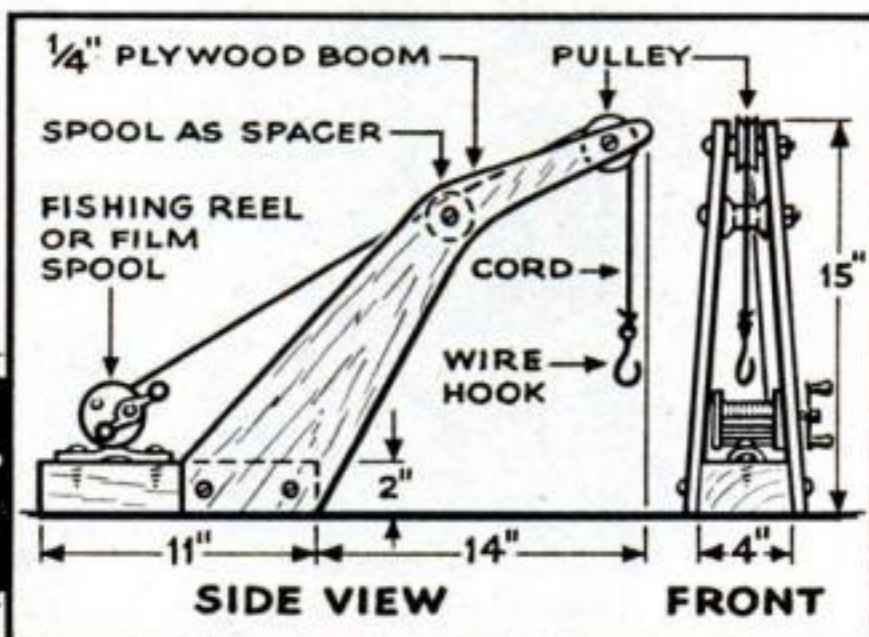
Riding a laundry chute is dangerous fun. This latch will stump a child.



A trough bolted to the gas stove as shown will put the valves out of reach, though grown-ups can still use them.

Homemade Crane Uses Old Fishing Reel as Winch

LOADING and unloading toy trucks and trains has endless fascination for children. This simple crane makes it even more fun.



Bevel two edges of a wooden block (a piece of two-by-four will do) and fasten to it two plywood pieces for the boom. Mount a small pulley at the top, a thread spool at the bend, and an old fishing reel or a film spool on the base. Bearings for a film spool can be pieces of plywood mounted behind the boom. Use a tight-fitting dowel for a shaft and a bent nail as a handle.—Carl V. Hanson, Renton, Wash.

Portable Reel Holds Extension



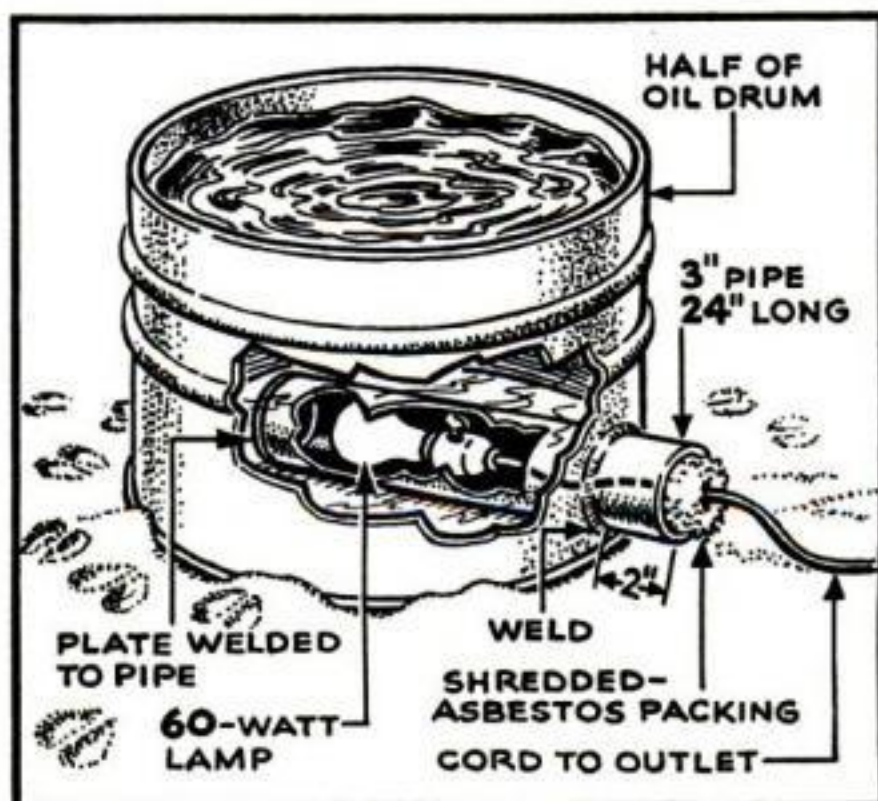
WEIGHING only 15 lb., a portable reel makes up to 400' of extension cord available for use by simply plugging in the device and pulling the wire. Current is fed to the revolving reel through collector rings. An adjustable brake controls rotation of the reel, which pivots on a ball-bearing swivel so the cord pulls off in a direct line from any direction. Industrial Electrical Works, Omaha, Neb., are the makers of the device.

Countersink Deburs Holes

HOLES drilled in sheet metal are apt to have an annoying burr underneath. This can be quickly removed with a common countersink, used in a power or hand drill.

Electric Engraving Tool Cuts Small Mortises

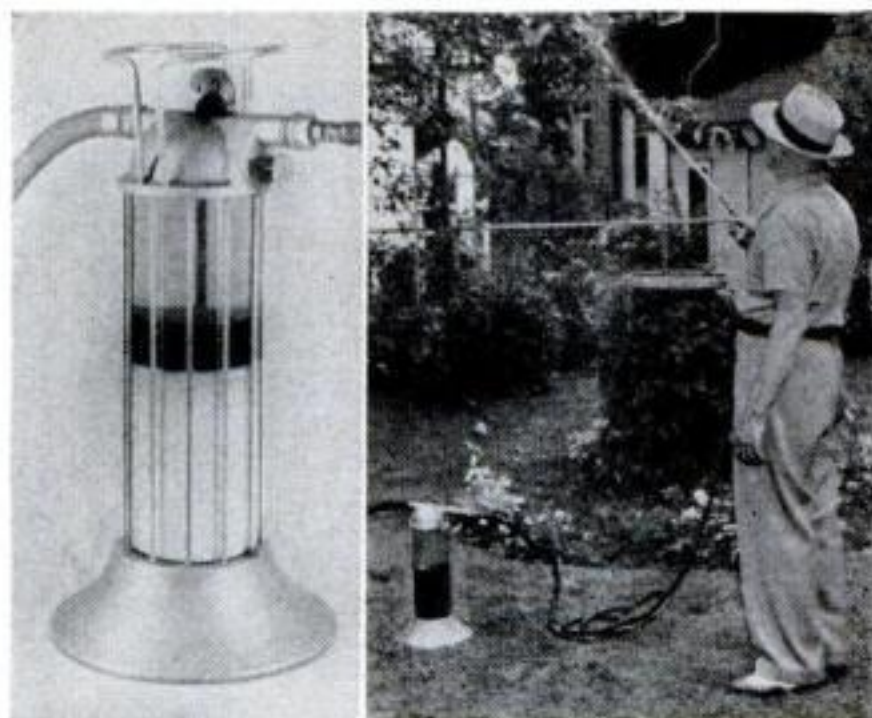
IF YOU don't know your own strength with a chisel, try an electric engraving tool next time you cut a mortise for a strike or a gain for a hinge. The vibrating blade supplies all the muscle, yet can be controlled to a hair. Mark around the hinge, or mount the strike temporarily to mark the area to be mortised. Using a straight wood-carving blade in the tool, make top and bottom cuts across the grain a little at a time. Remove stock with the grain to the depth of the cross cut, and repeat until the desired depth is reached.



Bulb Heats Hog Water Tank

WITH a tough winter over, I've found this hog-water heater so useful it's worth remembering for the next cold season. It consists of a length of 3" pipe welded shut at one end, fitted with a 60-watt bulb, and packed with asbestos. It's well to protect the lamp cord with boards or otherwise.—E. L. Sadowski, Ashland, Ohio.

New Lawn Aids Lighten Your Work



HERE are three products designed to help you keep your lawn in good order this spring and summer—an insect sprayer that you attach to a water hose, a lawn sweeper, and a mower that works on a new principle.

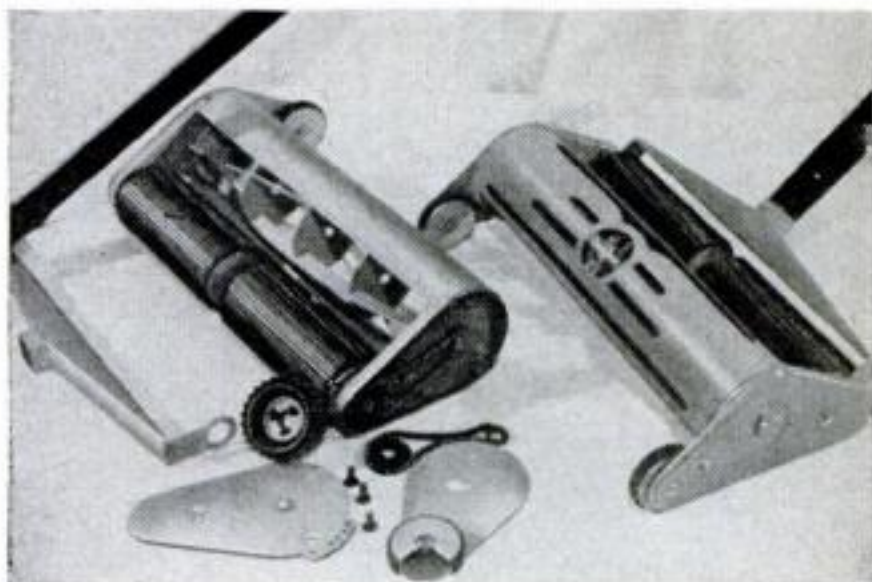
Upended for filling with insecticide, the sprayer is then placed on its base as above, the hose attached, and the water turned on. Water pressure against a free-floating piston inside the cylinder forces insecticide up a center tube into the outlet line. There it mixes with part of the water, one valve regulating the water flow and another the insecticide. Adjustment of the valves will produce a solution of any desired strength. Ottoson Product Co., New York, makes it.

Rotating brushes in the lawn sweeper (right above) pick up leaves, freshly cut grass, or other debris as it is pushed along. The sweeper is made by Parker Pattern and Foundry Company, of Springfield, Ohio.

Weighing less than 20 lb., the lawn mower is chain-driven by two rubber-treaded



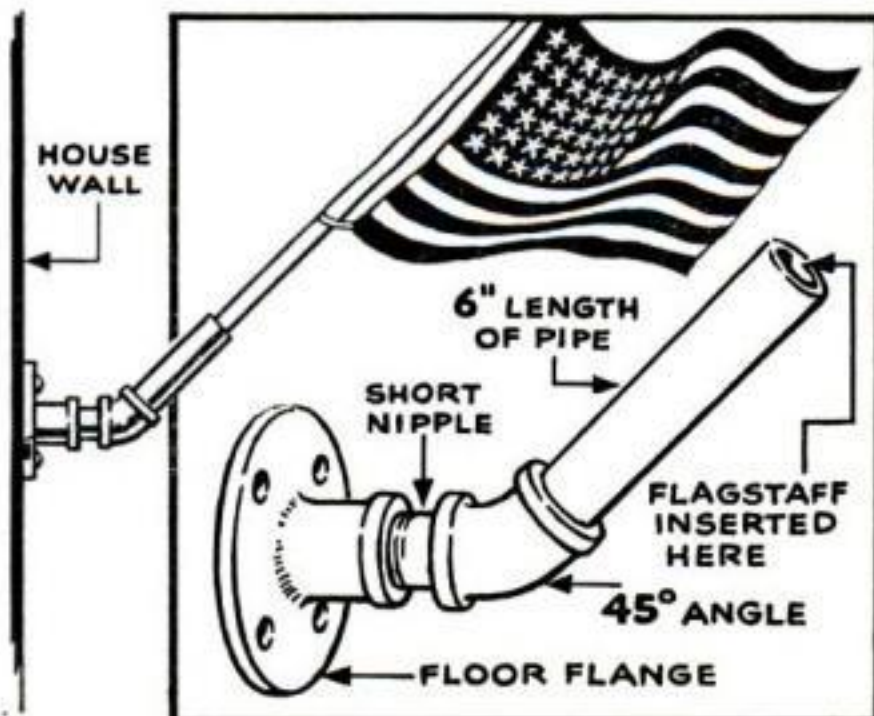
rollers at the rear. Since these cover a broad area, the cutting reel does not dig into the sod when you mow around flower beds. The cutting width is 17" and the cut height adjusts from $\frac{1}{2}$ " to 2". Shown below in both assembled and disassembled form, the mower, made by J. M. Dalglish Co., St. Paul, Minn., sells for about \$15.



Flag Bracket Made from Pipe

IN ORDER to display the flag on holidays, I assembled a simple bracket from a few pipe fittings and installed it on the front of my house.

A floor flange, a short nipple to fit it, a 45-deg. elbow on the nipple, a 6" length of pipe turned into the elbow, and a coat of aluminum-type paint completed the bracket. The inner diameter of the pipe must of course suit the flagstaff diameter. When the bracket isn't in use, a cork is inserted in the pipe to keep out water.—George F. Luippold, Hampton, N. H.



How to Seal

Standard materials and a simple home method give you a beautiful finish that just can't wear off.

By Rollin H. Wampler

Consulting Chemist, Paints and Varnishes

WITH most wood finishes beauty is really only skin deep. A surface film of varnish or other material gives good looks, fine weathering properties, and water resistance. What more can you ask? Not much—unless the piece is subjected to hard mechanical wear. In such cases you want the finish to get right down into the wood and key itself firmly into the fibers. In short, you want a penetrating finish. You can get one with the same materials you'd use for a surface job.

The photos show a stain-and-varnish finish suitable for cabinetwork and furniture. Assuming that you have filled all holes and scratches and sanded the surface smooth, you are ready for the first step—staining. The stain should be either of the water or



1. Staining, if required, is the first step. Use only a water or non-grain-raising stain. When dry, sand lightly with 6/0 paper.



2. Varnish for the penetrating coat is thinned with an equal volume of turpentine; for the sealing coat it is reduced only half as much.



4. Wait 10 minutes after applying the first coat; then wipe off any material that remains on the surface. Allow about four hours to dry.



5. Sand the surface lightly (again using 6/0 paper) and dust it off. Apply a second penetrating coat in the same manner as the first.

a Finish into Wood

non-grain-raising type. Don't use a pigment-wiping or penetrating-oil stain as these materials may interfere with the penetration of the locking coats. Apply the stain as directed on the can. After it is dry, sand lightly.

If there's any trick to applying a penetrating finish, it consists chiefly of letting the wood soak up an ample quantity of varnish or other material. Use good floor varnish reduced with an equal volume of turpentine. Brush on a coat liberally, let it set for a few minutes, and then wipe off any that remains on top. When this first penetrating coat has dried, sand it lightly. Apply a second coat in the same way.

Wood filler—required with open-grained woods such as oak, mahogany, walnut, or ash—is put on between the penetrating and sealing coats. Brush on thinned paste filler and allow it to set until the surface is uniformly dull and free from glossy spots. Wipe it off with straight strokes across the grain. Clean up by wiping lightly with the grain. Let dry overnight.



3. The penetrating coat is applied with a full brush. Put on all the wood will absorb, as you want to impregnate the top layers thoroughly.



6. A sealing coat and one or more full-body coats are brushed on uniformly. Don't wipe off the excess, but allow ample drying time.

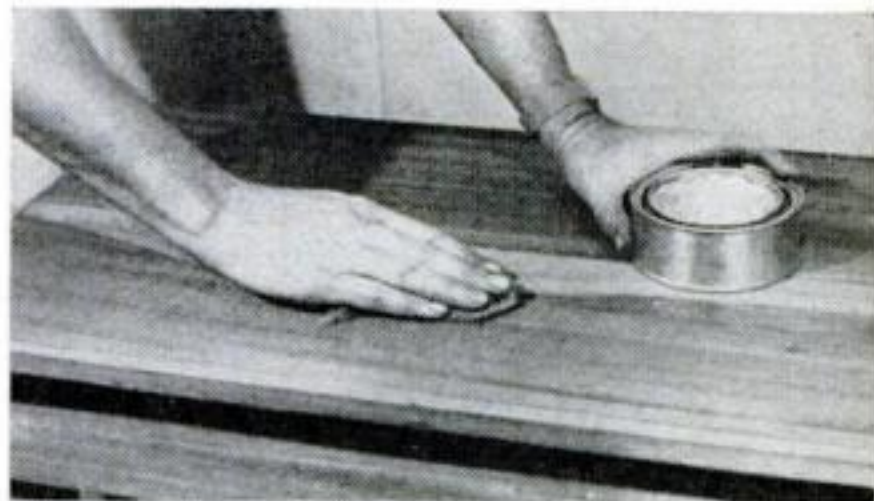
Next comes a sealing coat of varnish reduced with half its volume of turpentine. Apply a thin coat uniformly over the entire area. Let it dry overnight and sand lightly.

The final coat is floor varnish at full body. When it is thoroughly dry—which may take two or three days—go over it with a 000 or 0000 steel-wool pad loaded with paste wax. Stroke with the grain. Polish with clean rags. If the finest appearance is desired, add one or two extra full-body coats, wet-sanding between. When the last coat is thoroughly hard, rub with rotten stone or fine pumice and oil.

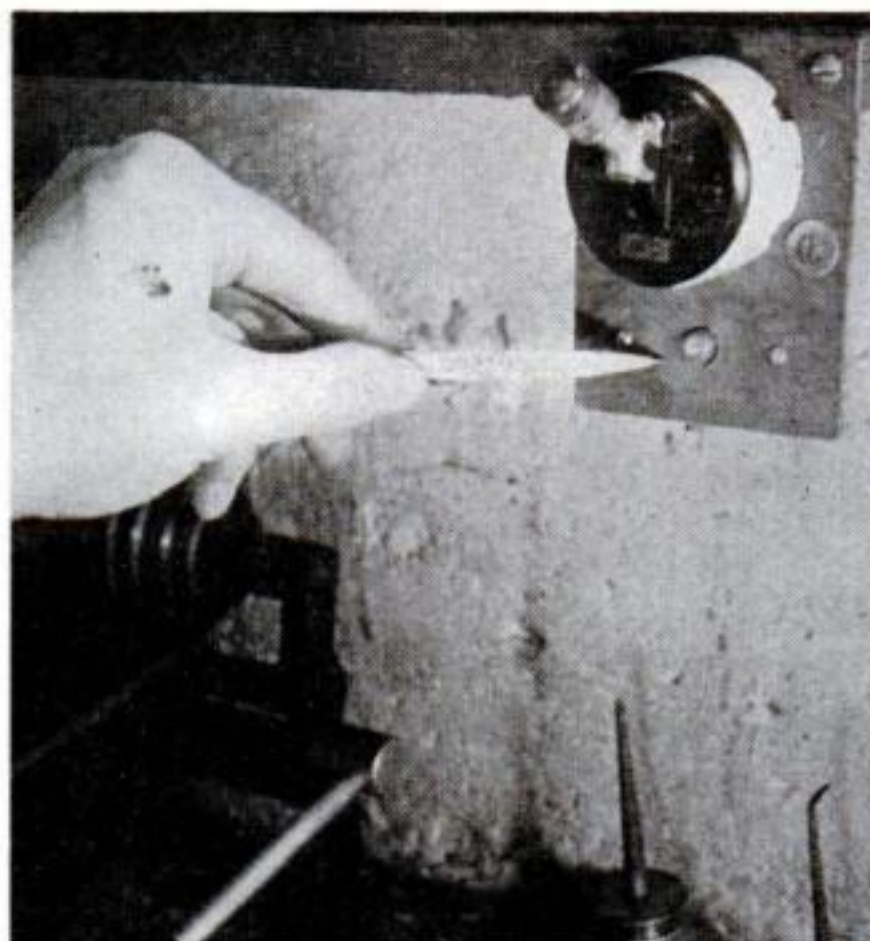
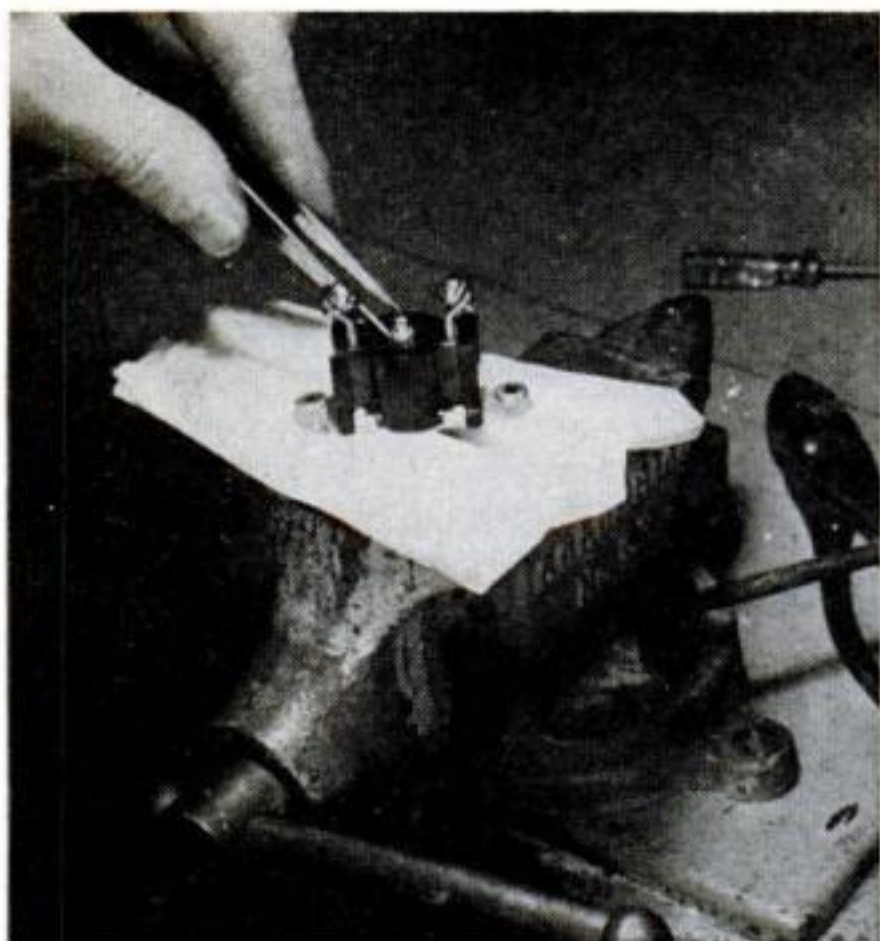
Now if you bear in mind that it is the penetrating coats that make the difference in this system, you will readily see how simple it is to adapt the technique to lacquer and enamel as well as to varnish. Use a tough material—linoleum lacquer, for example, or porch and deck enamel. Thin it with lacquer thinner or turpentine as the case may be, and follow the sequence described. When using lacquer, be sure to wipe off excess material within about three minutes; allow penetrating and sealing coats to dry one hour and the final coat eight hours or more.

For service out of doors, where a finish has to withstand weathering as well as mechanical wear, a penetrating job has extra years of life. Lacquer has poor weathering qualities on wood, so use varnish or enamel. If you choose the former, get the best spar varnish and apply three full-body coats over the sealer. Allow each 48 hours for drying.

When enameling porches, use one or two coats of thinned deck enamel on the raw wood. The excess need not be wiped off. Follow with one or two coats at full body.



7. Load a pad of steel wool with paste wax and go over the top coat. For a still finer finish, build up enough surface to permit rubbing.



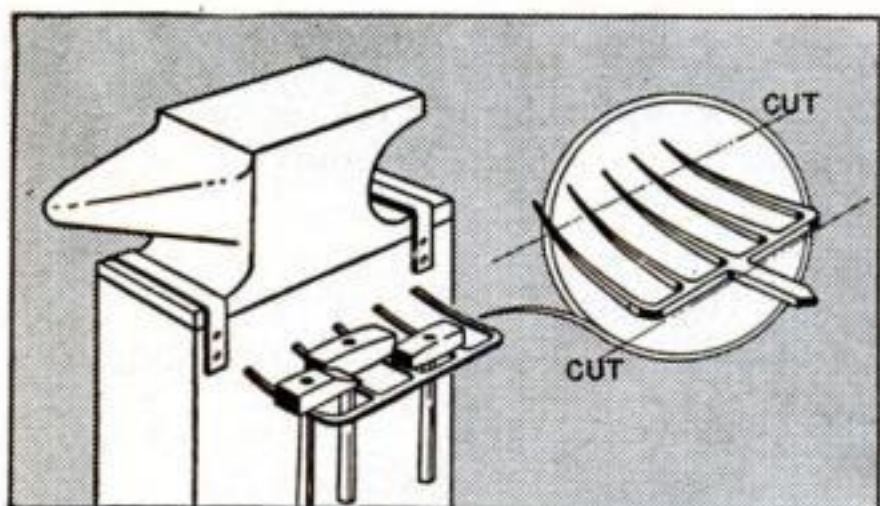
Circuit Breaker Guards Motor and House Fuses

SHOP motors not equipped with overload trippers can be protected, and house fuses kept from blowing, by means of inexpensive circuit breakers now available at war-surplus outlets. A push on a button resets them after they "blow." Although they are commonly set to open at 15 amp., you can readjust them to 9 or 10 amp. to safeguard motors drawing 4 to 6 amp.

Pinch off the sealing wax on the adjustment screw in back and loosen the lock nut. Rig up a temporary electric load of about

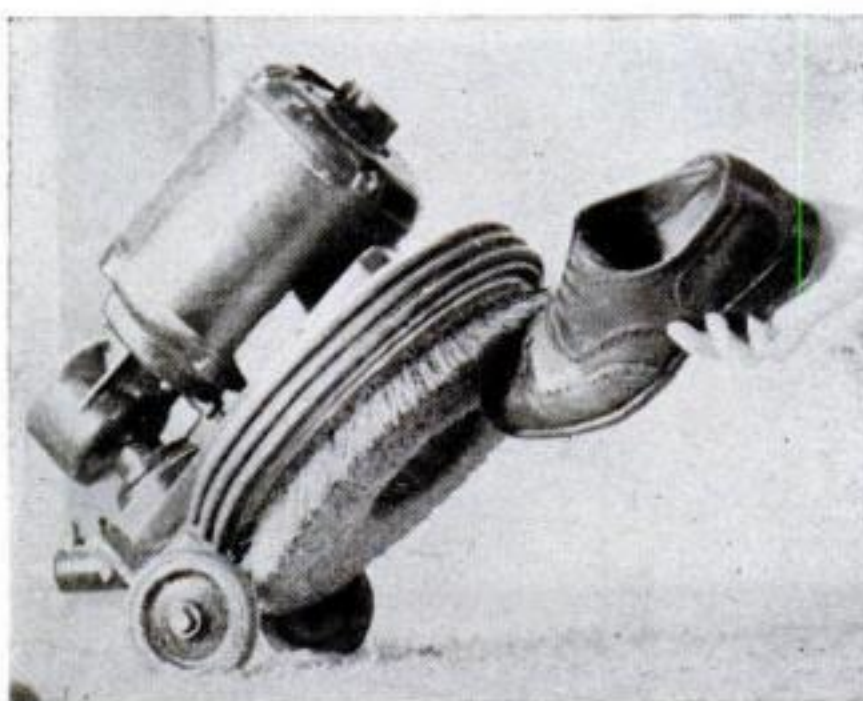
1,000 watts, using toasters or other appliances, and feed this load through the circuit breaker. Turn the adjustment screw until the device just trips. A thermostatic element heats up to open the circuit. If overloaded a second time while still hot from the first, it will trip prematurely, so give it time to cool between trials.

Tighten the lock nut, apply sealing wax or nail polish, and mark the new rating on the circuit breaker. Mount it near the motor switch with the reset button accessible.



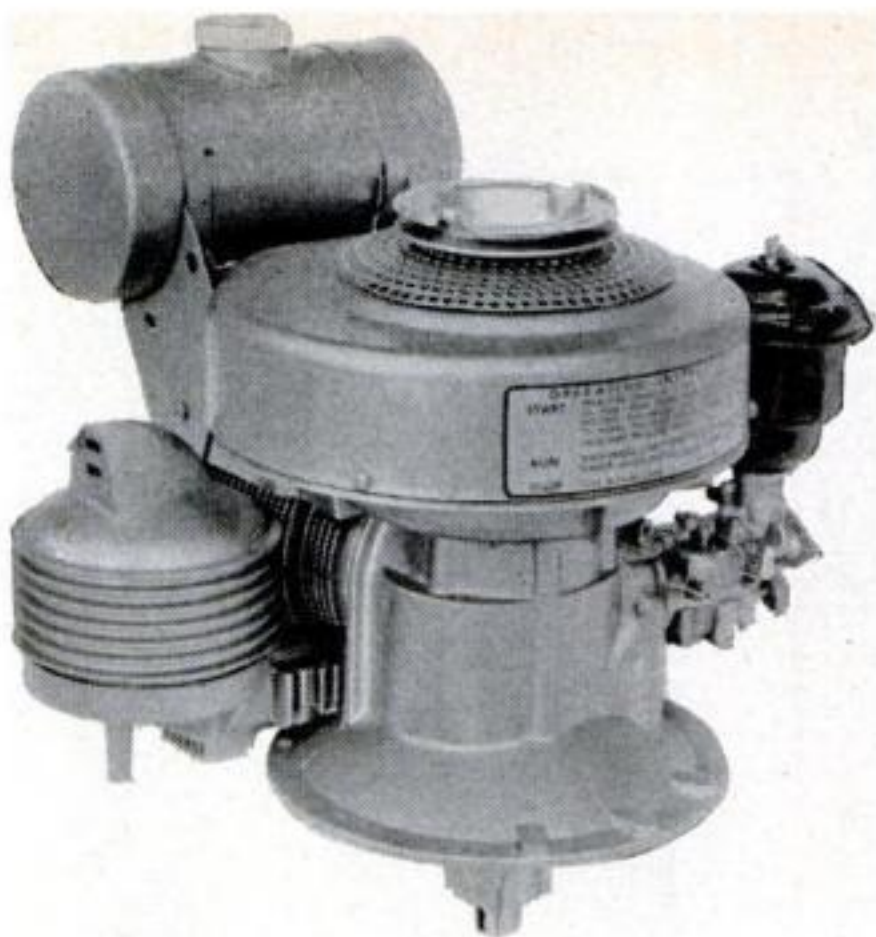
Fork Makes Handy Anvil Rack

TIRED of picking up sledge hammers and cutters from the floor of the shop, I found an old pitchfork, cut off the shank, and trimmed the tines to a length of 8". After drilling $\frac{1}{4}$ " holes in the anvil block at a convenient height and spaced to suit the tines, I drove the altered fork into the wood. Now I can quickly lay my hands on the tool I want. It's always handily close to the anvil.—Robert J. Roder, Reist, Alta.



Floor Waxer Gives Fast Shine

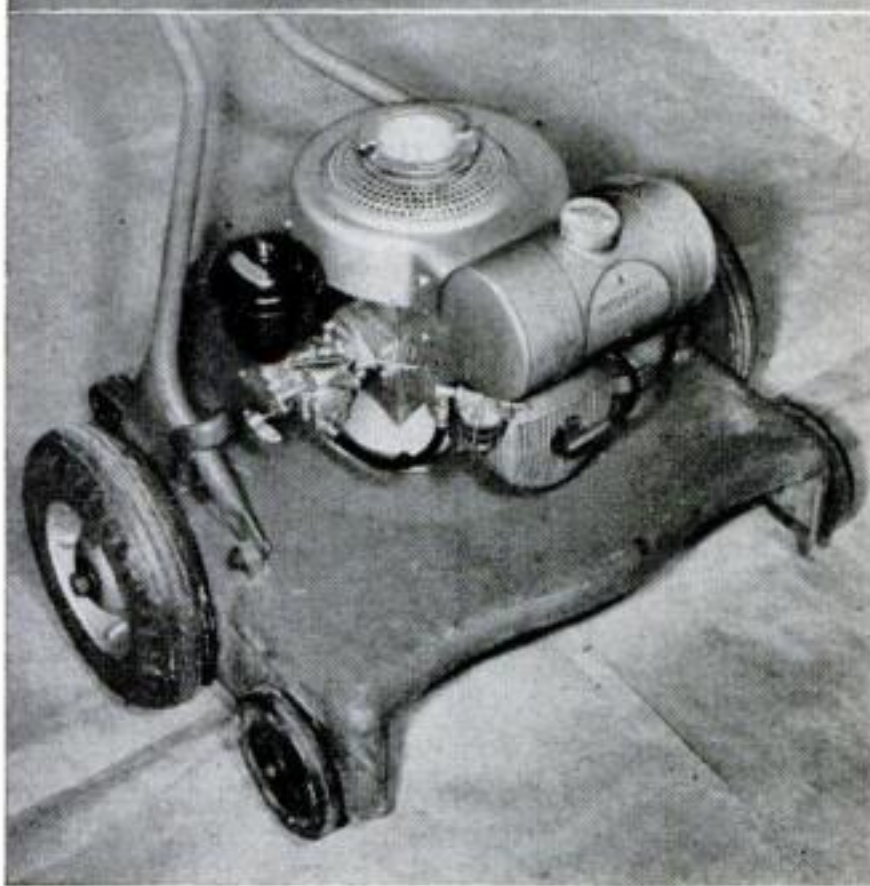
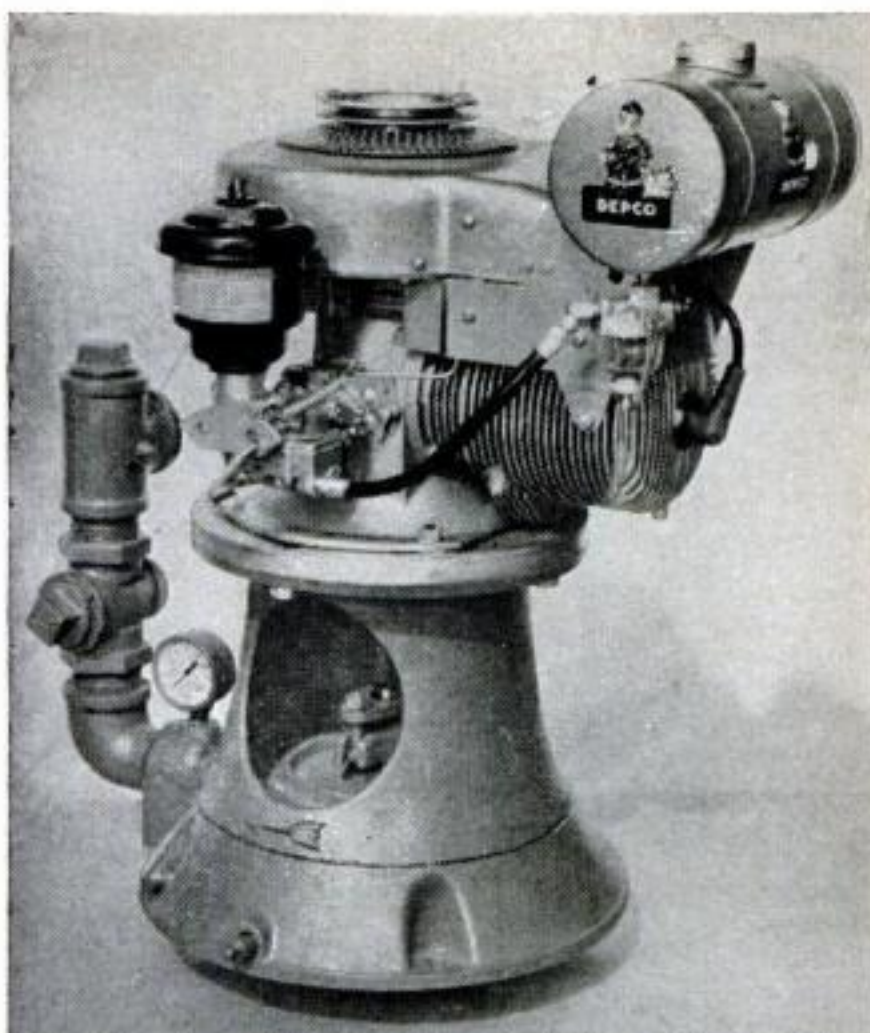
IF YOU can get next to a power floor waxer, shining your shoes ought to be no problem at all. Tilt the machine to expose the brush, put polish on the shoes, and let the motor shine up your footwear.—Russell W. McCandless, Manhattan, N. Y.



New Engine Has Vertical Shaft

SUITED for use with rotating-scythe lawn mowers and vertical pumps, a new single-cylinder air-cooled engine has many interesting engineering features. Although it weighs only 24 lb. complete, it delivers 2½ hp. at 2,500 r.p.m. The price of the engine, which is made by McCulloch Motors Corp., of Los Angeles, is \$79.50.

The high power-to-weight ratio is secured in part through use of aluminum-alloy die castings for the cylinder, crankcase, and fly-wheel. (The cylinder is lined with a cast-iron sleeve.) Another weight saving comes from the use of the two-cycle principle, with its elimination of valves, camshaft, and associated parts. A patented "reverse-flow" scavenging system that uses guide vanes at the intake ports, together with a special high-tension ignition system, are said to provide easy starting.

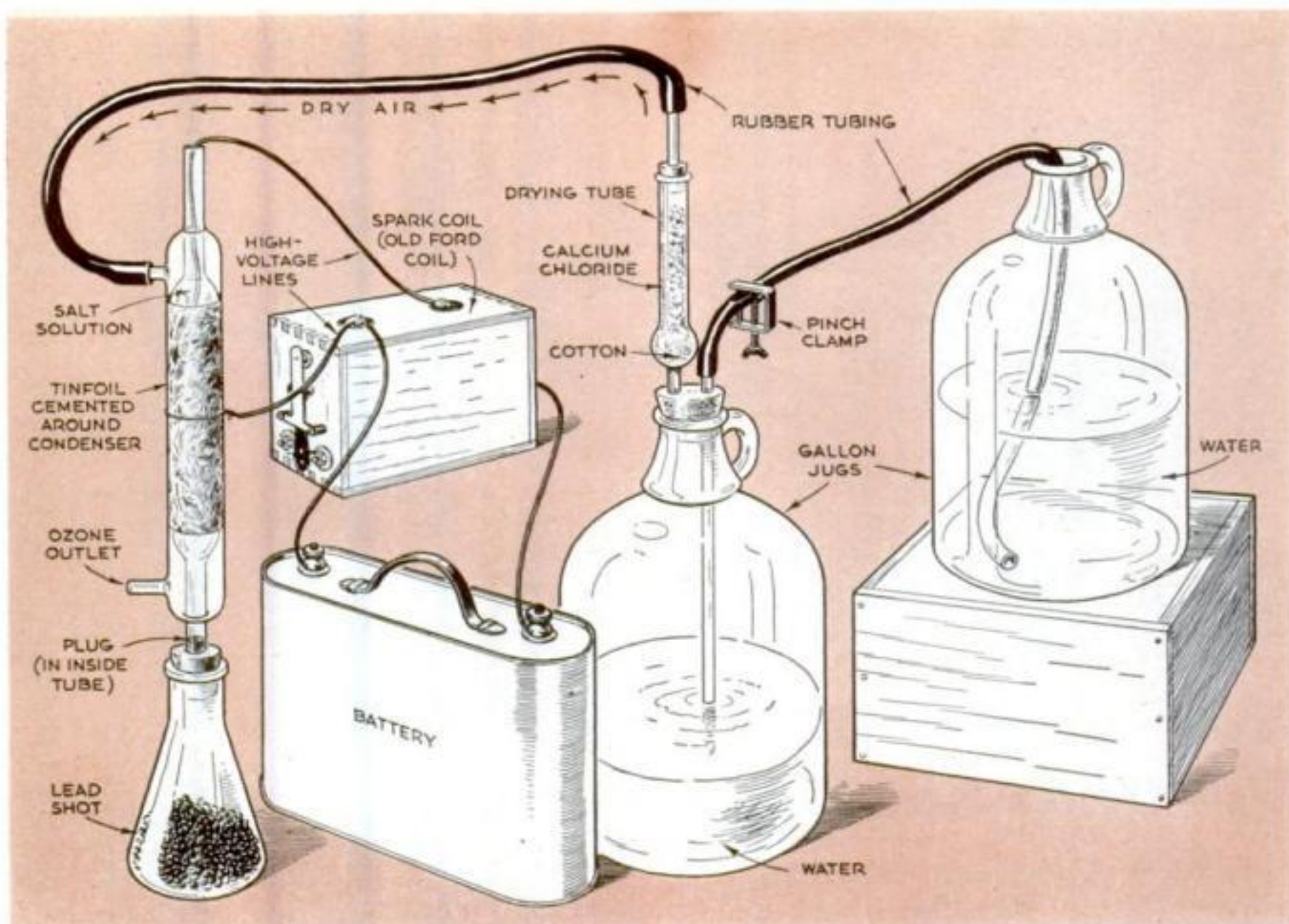


Other features of the little engine include anti-friction bearings throughout, a visible-sediment fuel filter, an air-vane governor, and an oil-bath air filter.

Wheelbarrow Uses Motor

ROUGH ground is scarcely an obstacle for this home-made wheelbarrow built by Harold T. Austin, of Seattle, since its spiked driving wheel will climb almost everything but a tree. At the right Austin is shown giving his contrivance a test hop over a pile of crates. A two-wheeled 125-lb. job with a bent tubular frame, it is driven by a 1½-hp. air-cooled engine through a chain and V-belt speed-reduction system. Wheelbarrow handles fitted with engine controls steer the device, which can carry a 250-lb. payload.



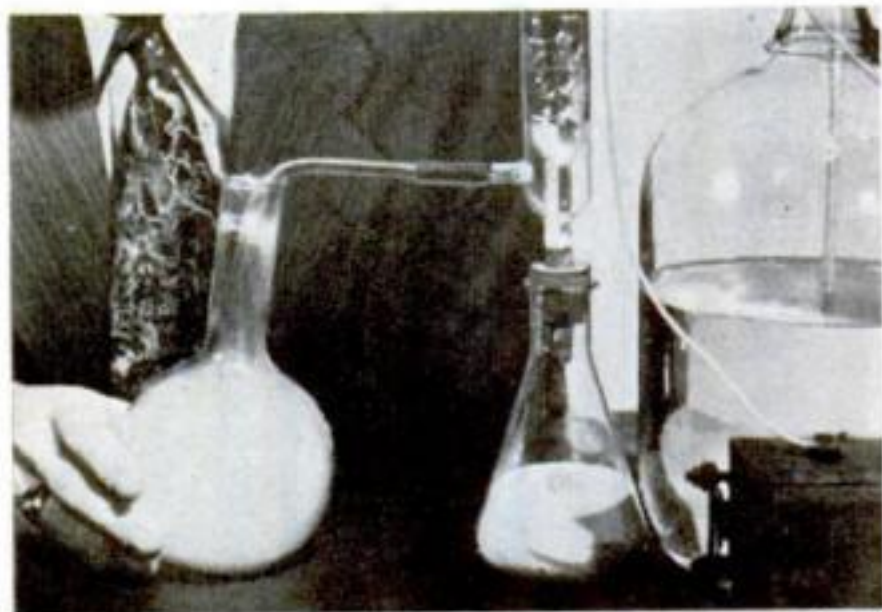


Ozone may be generated with this setup. Siphoned water forces air through the condenser.

How Elements Put on Disguises

Soot, pencil lead, and diamonds are all masquerades of pure carbon, its molecules playing Jekyll-Hyde.

By Kenneth M. Swezey



This test shows you have made ozone. Led into a flask containing a little turpentine, ozone from the generator reacts with the vapor and forms a white cloud of ozonide of turpentine.

INCREDIBLE as it may seem, a hard sparkling diamond, soft greasy graphite, soot from a candle flame, and charcoal are exactly the same thing, chemically speaking. Each consists of the element carbon.

Such different forms of the same element are called allotropes. Scientists have not yet fully solved the mystery of allotropes, but evidently the differences apparent in various forms of the same element result from different arrangements of the molecules or of the atoms in the molecules.

Some elements with such Jekyll-Hyde characteristics are so amenable to change that you can readily transform one allotropic form into another. Oxygen, and its allotrope ozone, are a good example.

The oxygen we breathe is a gas with molecules made up of two atoms of the element oxygen. Ozone molecules, on the other hand, have grabbed themselves an extra atom, and this three-atom type of oxygen has far differ-

ent properties from the garden variety found in the air. Because of these properties, ozone is useful to us in a number of ways. (See page 162).

Several methods are used commercially and experimentally to produce ozone, but you can do it most simply by passing a high-voltage electrical charge through air. This causes molecules of ordinary oxygen to attach another atom to themselves.

Building an Ozone Generator

A Model-T Ford spark coil will supply the high voltage. For the generator proper, use an all-glass condenser. Cement a wide band of tin foil around it, place a plug in one end of the inside tube, and minimize the danger of shock by mounting this end in a stopper pressed into a weighted flask.

Connect one of the high-voltage terminals to the tin foil and immerse the other in a solution of salt water placed in the inside tube. The remainder of the apparatus merely forces a stream of dry air through the jacket of the condenser.

When the apparatus is all set, fill the top jug with water, start it siphoning into the bottom one, and connect the spark coil to the battery. You will notice a faint bluish light between the tin foil and the inside condenser tube, and within a few seconds you should be able to detect the characteristic odor of ozone as it comes from the outlet.

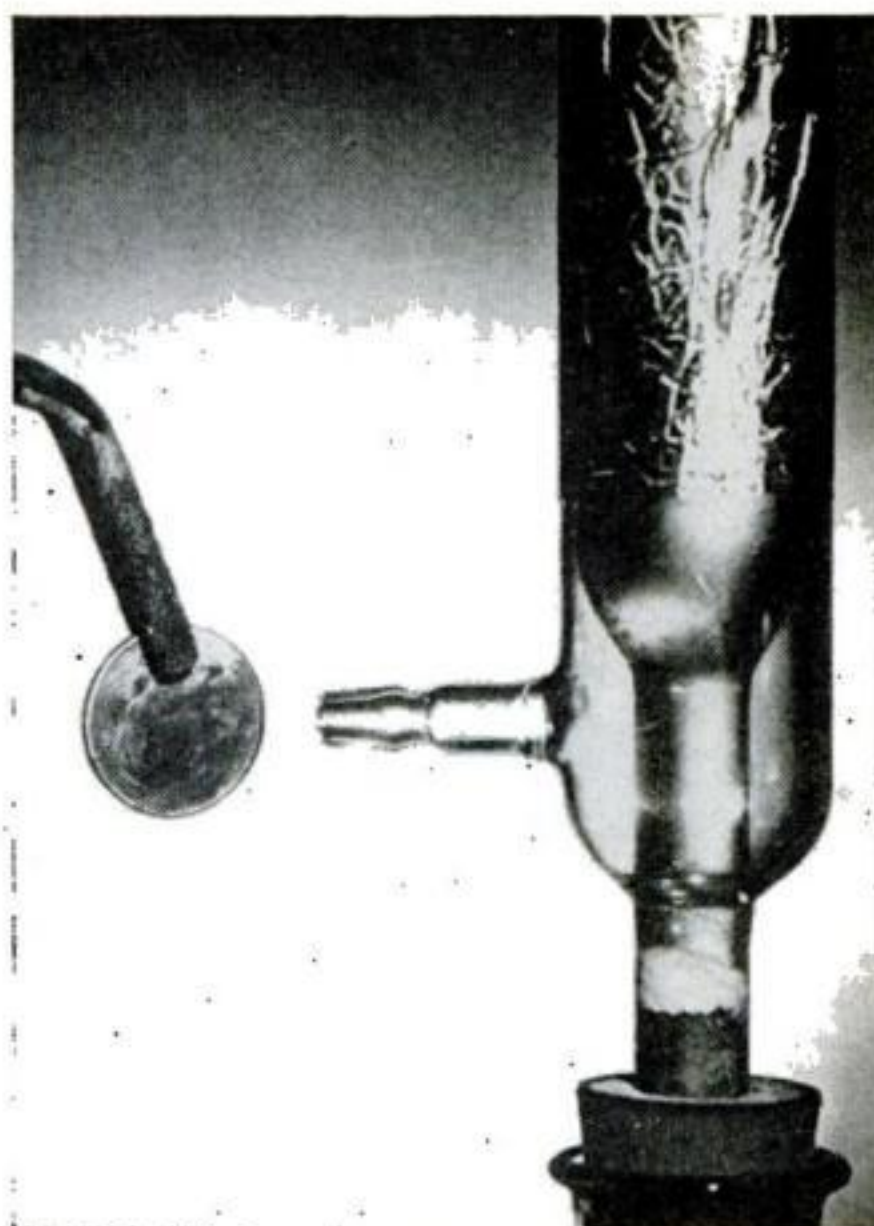
Strongly corrosive, ozone reacts more vigorously with many substances than does ordinary oxygen. In fact, in some cases it reacts where oxygen does not. Silver is one instance. If you polish a silver coin, heat it medium hot, and hold it in ozone, a dark film of silver peroxide will form.

Ozone Liberates Iodine

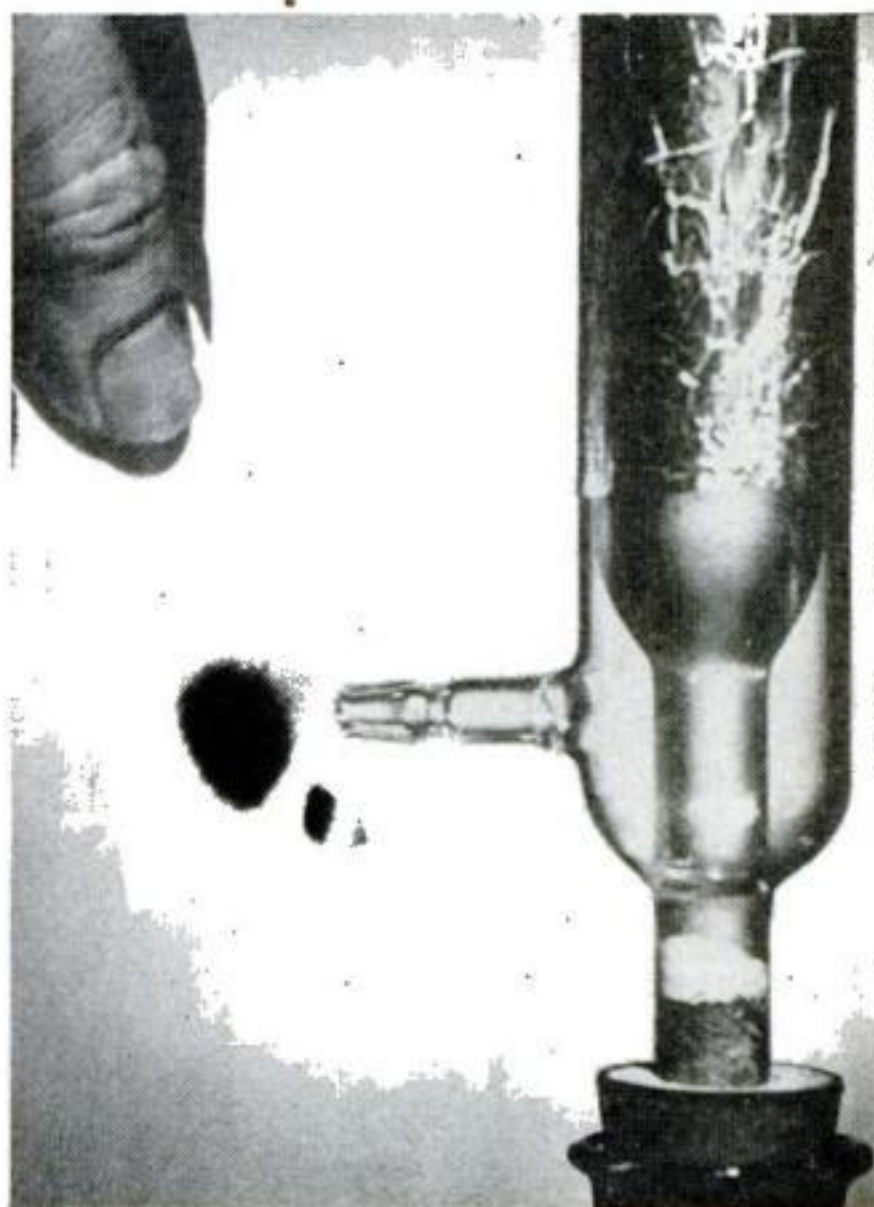
Another characteristic of ozone is that it liberates iodine from iodides. You may demonstrate this by dissolving a few crystals of potassium iodide in a little water and adding enough cornstarch to make a thin paste. Then apply the paste to a strip of filter paper and hold the paper near the outlet of your ozone generator. Liberated iodine will react with the starch, forming a tell-tale blue-black color.

Sulphur also occurs in several allotropic forms. Two are crystalline of entirely different structure. A third has the plastic quality of rubber.

In one of the crystalline forms, the crystals are needlelike, or monoclinic; in the other



Ozone reacts vigorously with many substances that ordinary oxygen does not affect. Silver is one example. Hold a heated silver coin in ozone and silver peroxide will darken it.



Ozone frees iodine from iodides. You may show this by applying a paste of starch and water containing potassium iodide to filter paper and holding the paper in the stream of ozone.



Sulphur occurs in a number of allotropic forms. One may be molded like putty. To produce this, heat some sulphur until it is thicker than molasses and pour into cold water.



Red phosphorus can be made from the white form. Slightly warm some of the latter and add a speck of iodine. Iodine acts as a catalyst in effecting the change in forms.



White phosphorus in powder form flames up spontaneously in open air. The red variety produced at the left may be quickly changed back into the original white phosphorus.

they are rhombic, shaped somewhat like little coffins. Rhombic crystals are stable below 96 deg. C., while monoclinic crystals are stable from that point to the melting temperature—about 114.5 deg.

To produce monoclinic crystals, fill a test tube about a third full of powdered sulphur, and heat carefully so that the sulphur melts with the least possible heat. Pour the melted sulphur into a cone formed from a sheet of filter paper, holding the cone by one edge in your hand. When crystals have begun to form across the surface, pour the excess liquid into cold water. Break open the cone when cold and notice the crystals.

For the rhombic type, dissolve as much sulphur as you can in about 10 ml. of carbon disulphide. (Keep this far from any flame, for it is highly inflammable.) Then filter the solution and pour into a small beaker. Cover with a piece of glass and stand it in a cool, well-ventilated room to evaporate. When all the solvent is gone, the bottom of the beaker will be covered with the coffin-shaped crystals.

To make the third type, heat a third of a test tube of sulphur so strongly that it darkens and boils. Don't worry if the vapors at the mouth of the tube catch fire. When thicker than thick molasses, pour the sulphur into a beaker of water. It will cool into a puttylike mass.

Although all these forms of sulphur are chemically the same substance, they look

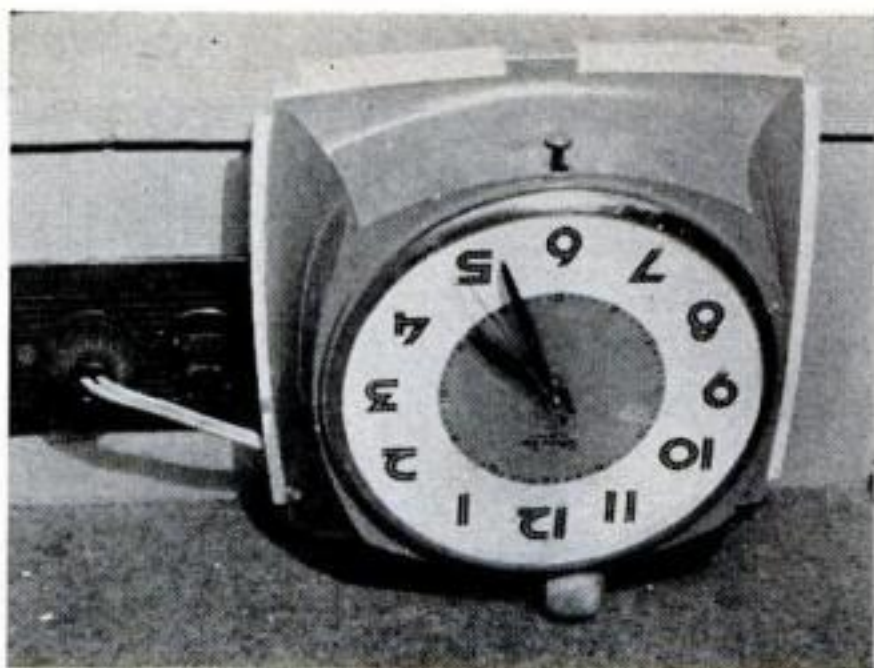
different, and only the crystalline forms are soluble in carbon disulphide. Left alone at room temperature, the monoclinic and plastic sulphur change to the rhombic form.

Two common allotropic forms of phosphorus also are remarkably different. White phosphorus is highly poisonous and often catches fire spontaneously. Red phosphorus is not at all poisonous and ignites only at higher temperatures.

White Phosphorus Changed to Red

Red phosphorus is easily made from white. Drop a pea-sized piece of the latter into a large test tube, supported vertically. (Never touch this substance with your hands. Use a pointed knife or tweezers and cut it under water.) Heat the tube gently until the lower part is filled with vapor. This will catch fire, but will almost go out when the oxygen in the tube is exhausted. Remove the heat and add a bit of iodine. Almost instantly, the white phosphorus changes to red.

The red phosphorus just formed can be changed back to the white variety by suspending a smaller test tube, filled with cold water, in the tube containing the red. Heat strongly. At first the phosphorus burns, but then it begins to distill, coating the bottom of the cool inner test tube with white phosphorus. Because this white phosphorus is so finely divided, it will catch fire spontaneously a few seconds after you bring it into the air. END

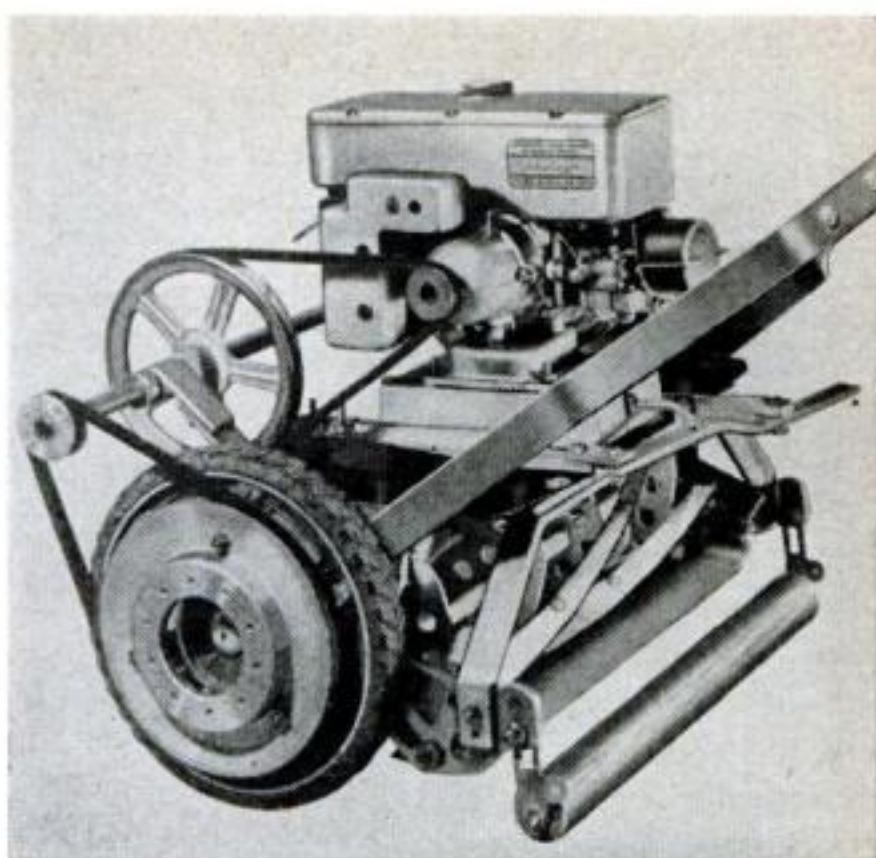


Silencing a Noisy Clock

ELECTRIC clocks may become noisy when the sealed-in lubricant settles. A simple cure is to turn the clock upside down and allow it to run that way for several days. Select a fairly warm place to help thin the lubricant.—*D. J. Bachner, Jackson Heights, N. Y.*

Plastic Box Traps Minnows

THE tendency of minnows to "school" is said to make this bait trap particularly effective since one or two will lure others into the transparent box. It folds compactly to fit the tackle box. Lewis E. Hamel Co., Inc., Rochester, N. Y., sells the trap for about \$4.



Attachment Motorizes Mower

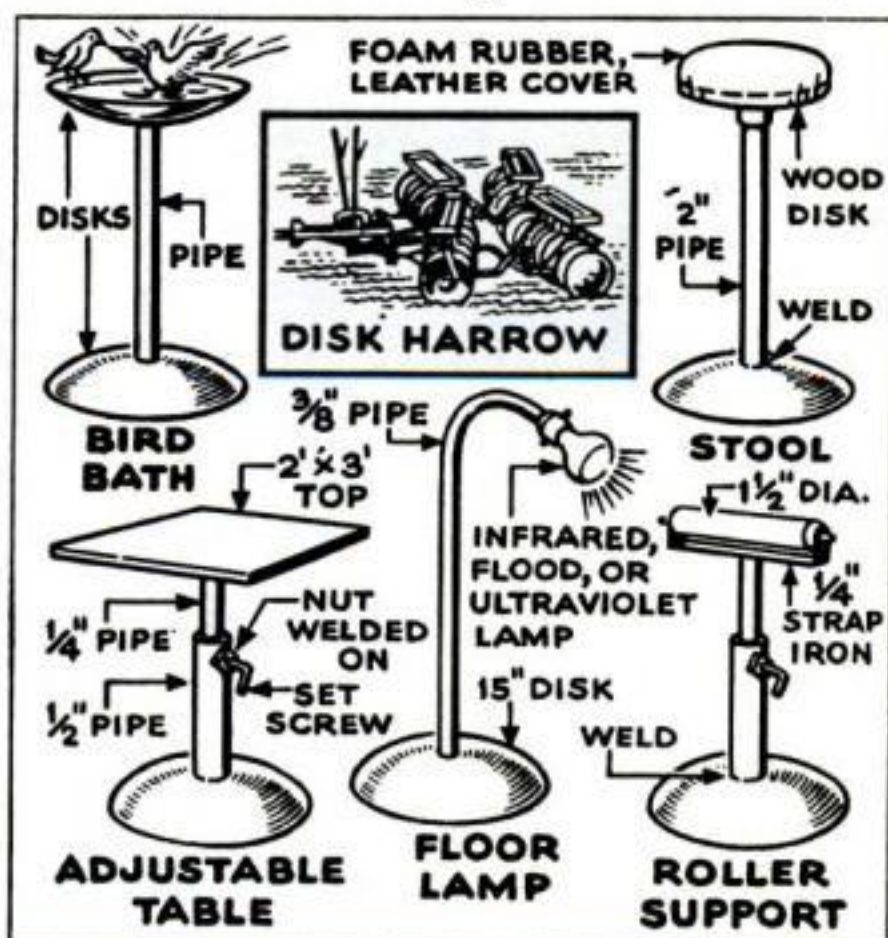
A SET of attachments and a light gasoline engine are now on the market for converting an ordinary lawn mower to power operation. The engine is a 2-cycle, 1-hp., air-cooled unit that weighs 17 lb.; the attachments are made of a magnesium alloy to keep the added weight to a minimum.

The Royal Oak Lawn Mower Shop, Royal Oak, Mich., makers of the attachment, claim that it can be assembled in an hour or less. All parts are numbered to make the job fool-proof. Gardeners who already own a suitable motor can buy the attachment alone for about \$28; the motor, also sold separately, costs about \$62.

Discarded Harrow Disks Serve as Shop Pedestals

WITH iron and steel still scarce and costly, I couldn't bring myself to throw away my old disk-harrow cutters even after I had replaced them with a new set. I'm glad I saved them, because I have discovered countless uses for the 15" hard-steel platters.

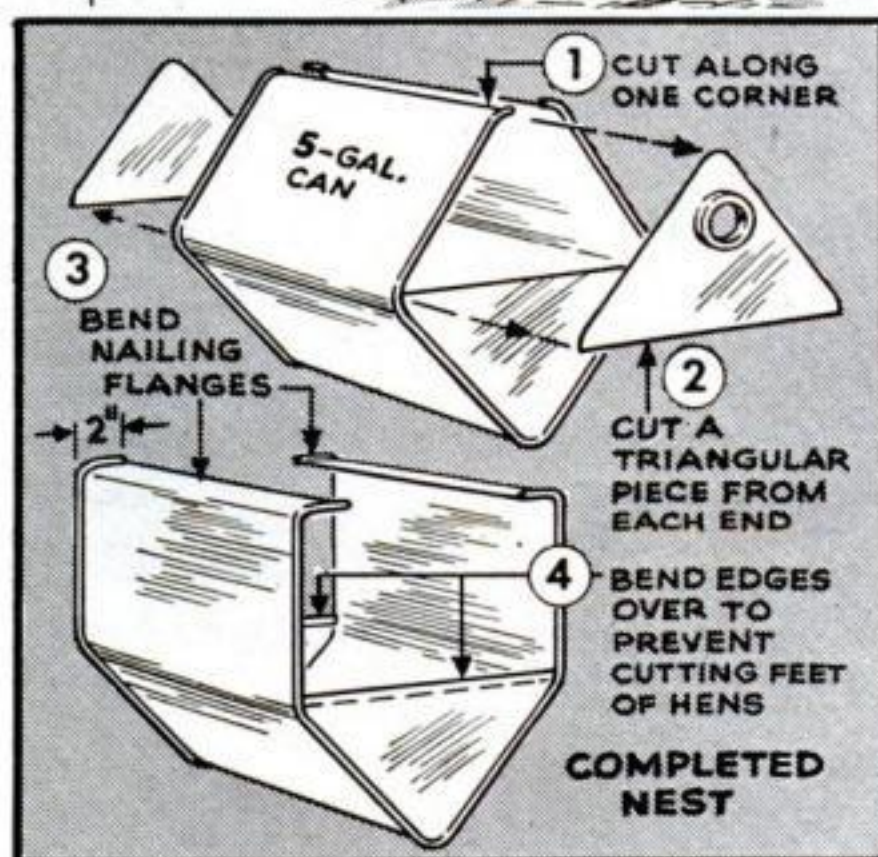
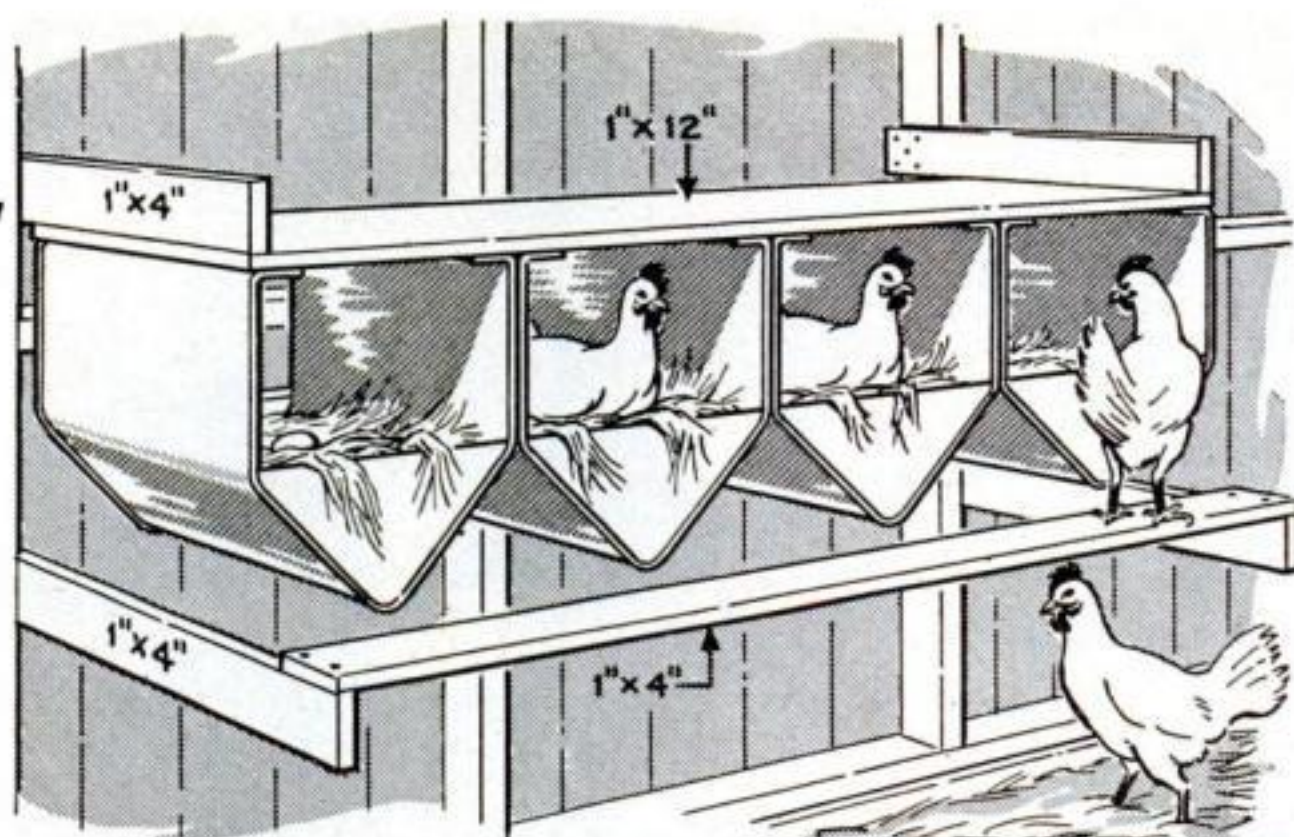
A few of them are indicated in the sketches at the right. In most applications the disks serve as bases for the various objects. They are sufficiently sturdy by themselves, but can be weighted where necessary for even greater stability. A length of pipe is welded to each disk to make the standard, and the top is also welded on. One standard with interchangeable tops may be used for the adjustable table and the roller support. The latter is handy for feeding long stock into a circular saw or other power tool.—*Neil P. Salter, Allentown, Pa.*



Laying Nests Made of Cans Are Easy to Clean

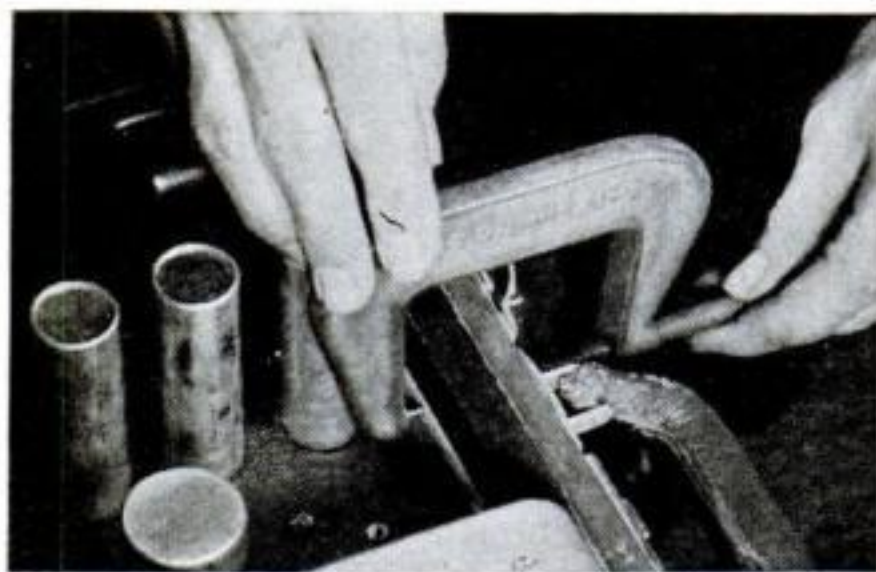
HENS favor these homemade laying nests over the flat-bottom kind in our laying house. The depth of the nesting straw and the sloping sides probably account for this.

To make them, first cut down along one corner of the 5-gal. cans. Next, cut out half the top with the filler spout along a diagonal as shown, and a similar piece out of the bottom. Fold over the cut edges. Bend a 2" strip along each edge of the cut corner for a nailing flange. Then straighten the sides and nail the nest to a board as above. Provide a perch in front of the nests to invite your layers to do their stuff.—E. L. Sadowski, Ashland, Ohio.



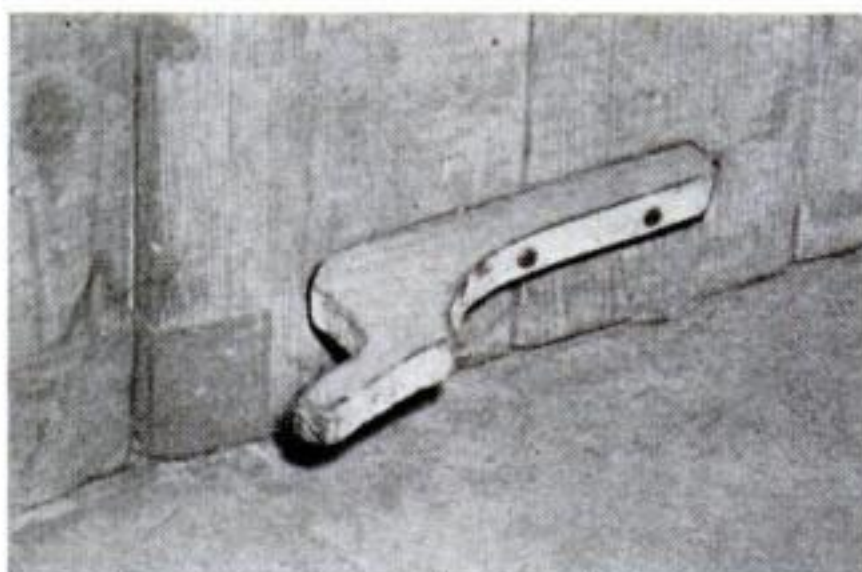
Roughing Smooth Concrete

SMOOTH sidewalks can be made less slippery by acid etching, which exposes some of the aggregate. The method, recommended by the Portland Cement Association, is to wet the surface and then to apply a 10-percent solution of muriatic acid. Let this stand until the surface is sufficiently etched. Rinse off thoroughly with water.



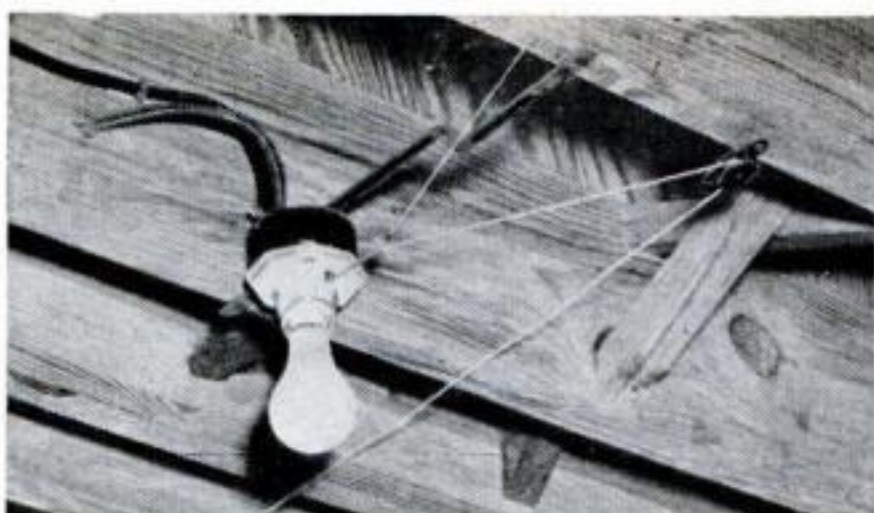
Starting Hard-to-Reach Screws

CLEATS had to be screwed on inside the carrying case to hold an amplifier. Hammering failed to start the wood screws. With no room to use a drill, they were pressed part way into the wooden wall with a C-clamp, and tightened with a screwdriver.



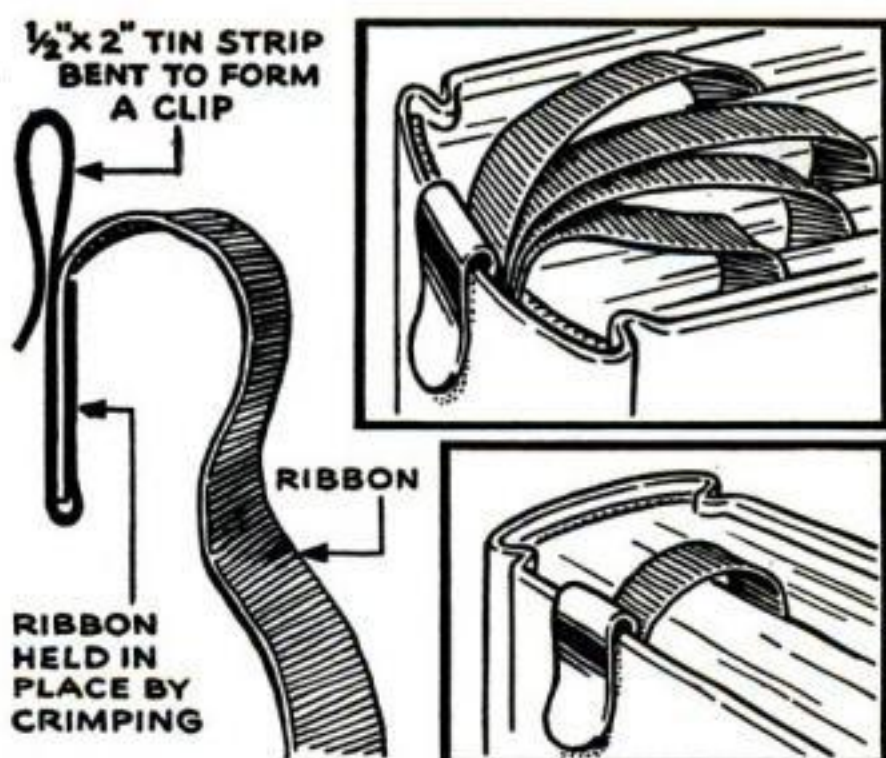
Cellar Door Opened by Foot

THE simple wooden bracket fastened to the bottom of this cellar door allows you to open it with a foot when both hands are full. A scrap of $\frac{3}{4}$ " plywood is the ideal material. Bandsaw the bracket to shape and attach it with two wood screws.



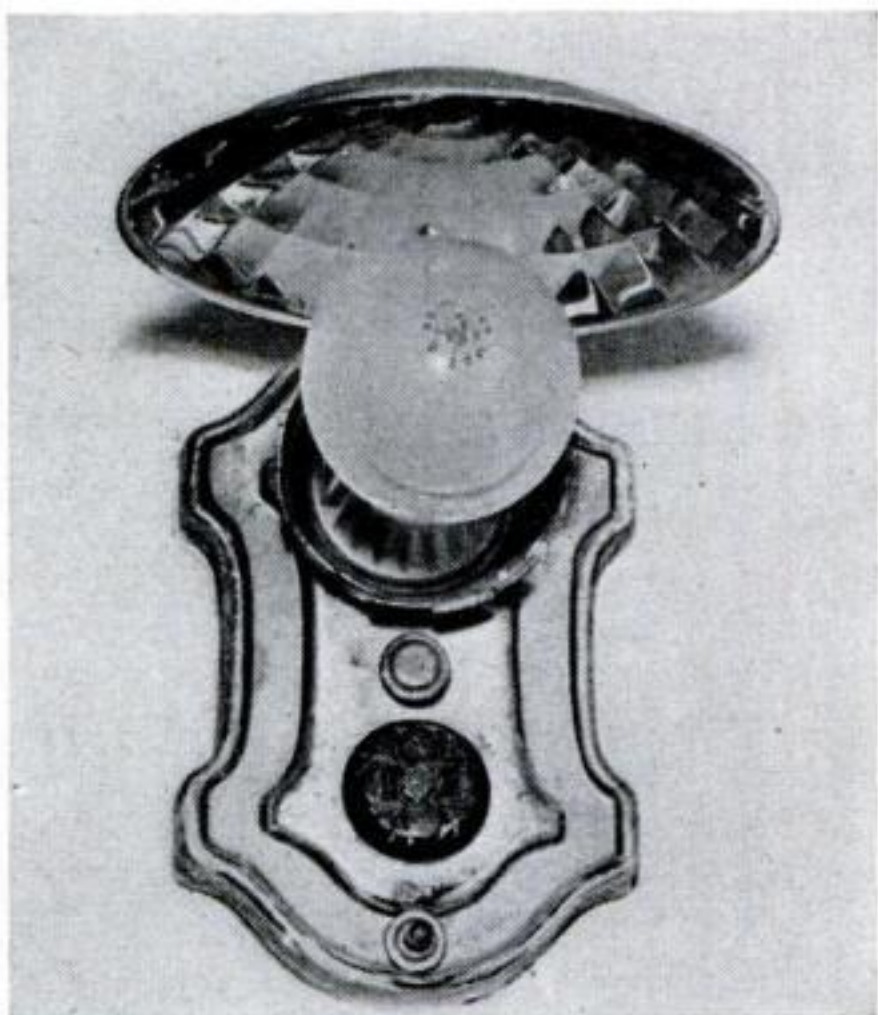
Pulley Reverses Switch Pull

RUNNING a cord from a light pull so that it can be operated at a distance or from two points is a familiar dodge. But the cellar light above was to be controlled from two opposite directions. One cord was therefore run directly to the spot. The other was carried over a small pulley and then back the other way. Although unnecessary in this case, a light spring can be hooked to this cord to keep it taut on the pulley.—*Glenn A. Wagner, Delmar, N. Y.*



Handy Bookmark Cut from Tin

THIS page marker keeps several places and won't drop out. Bend a strip of tin-can metal as shown. Crimp one or more 6" lengths of ribbon into the fold, using cement as well. Clip to the cover or back of the book.—*H. B. Crawford, Arcada, Wyo.*



Reflector Adds Shaving Light

A REFLECTOR of the kind used on photo flash guns gives extra shaving and makeup light from the type of bathroom fixture above. Slightly scratched reflectors can often be bought as "seconds" at a reduced price. The one shown was mounted by a short brass screw through its mounting bracket and one of the holes in the flange on the fixture that previously held the glass shade.—*D. J. Bachner, Jackson Heights, N. Y.*



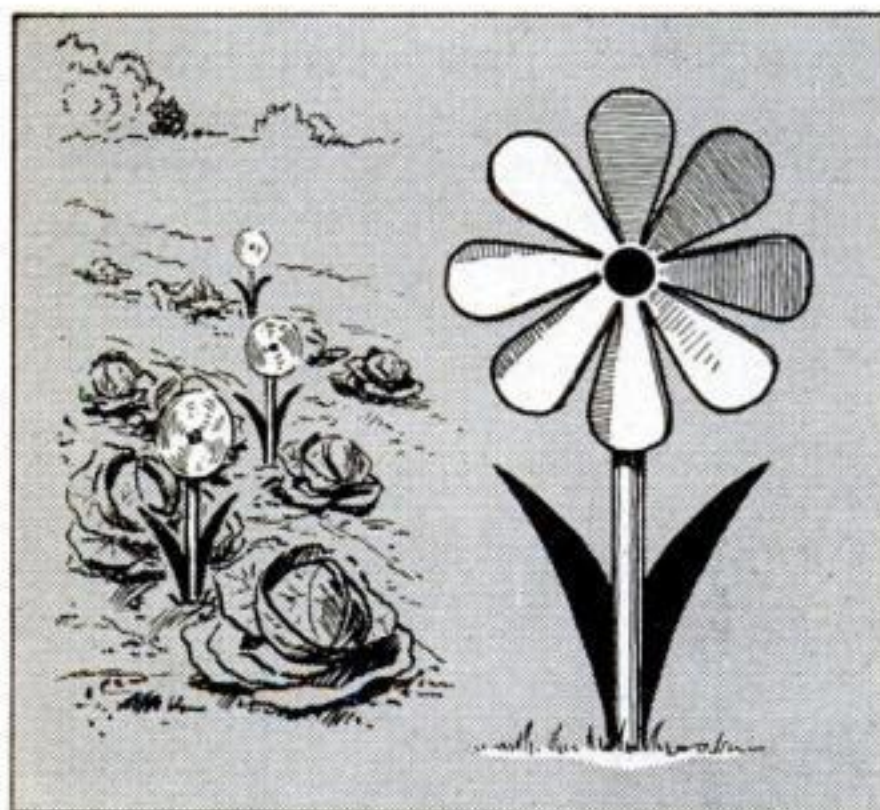
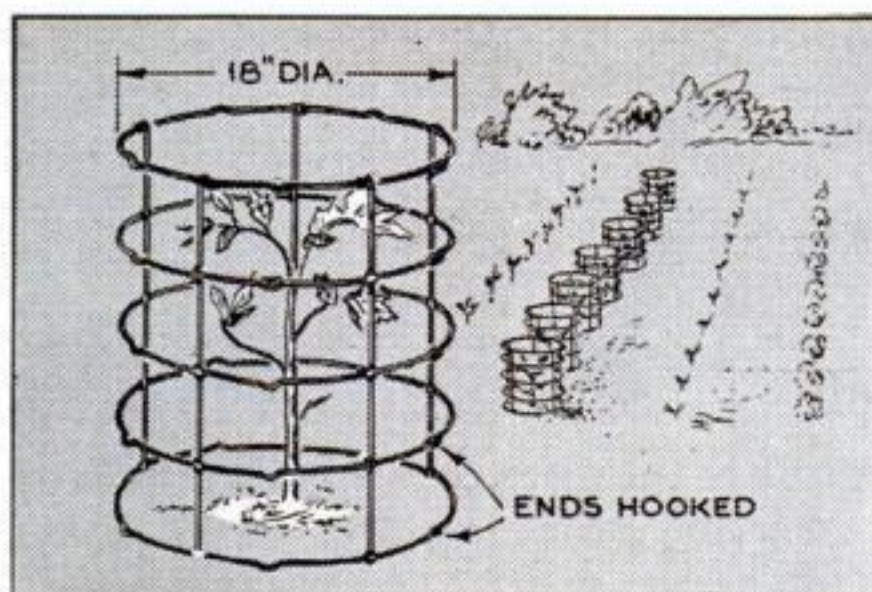
Tool Rack Built in a Jiffy

HERE'S an end to stepping on the rake in a dark shed or garage and having the handle remind you it's there the hard way. Two fruit boxes of the more substantial sort, with sides of 1/2" stock, and a couple of short boards will make a sturdy wall tool rack. Nail cleats to one side of each box, and nail the boxes between two joists a convenient distance apart. Cut two boards to fit, bore holes for the tool handles, and nail the boards to the cleats. Extra shelves may be put in for trowels, flowerpots, seeds, and so on.—*Marion L. Rhodes, Knightstown, Ind.*

Wire Racks Keep Tomato Plants Off the Ground

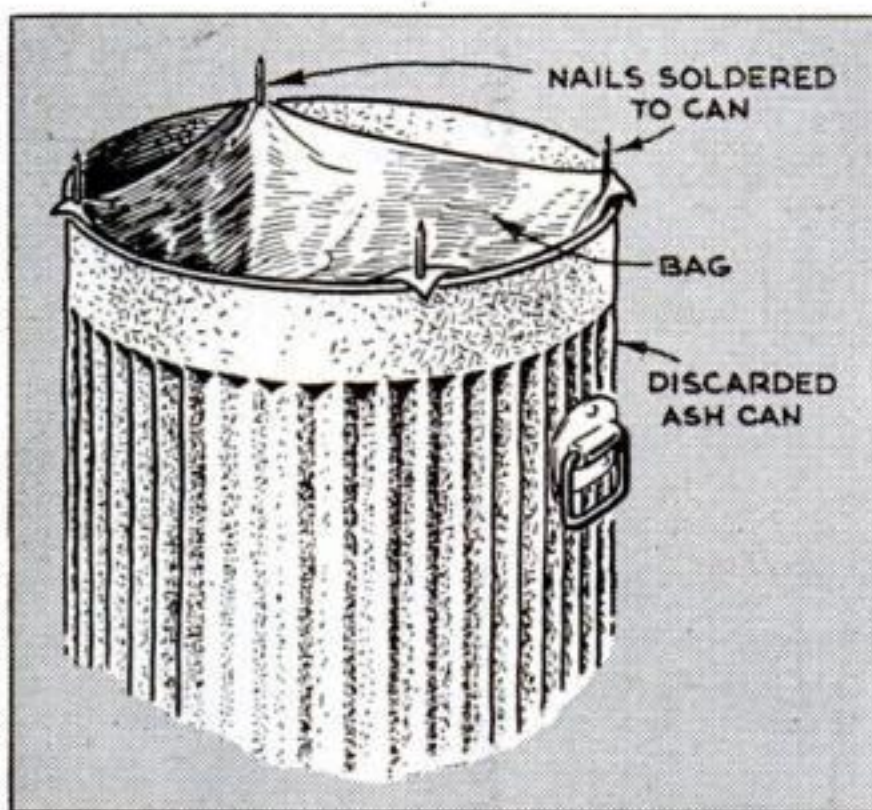
HERE'S an effective way of supporting tomato plants. From wire fencing 26" or 32" high, form cylindrical racks about 18" in diameter and set a rack over each plant while it's still small.

Racks are easily made by bending wire fencing in a circle and hooking the ends together. Press and turn the rack to imbed the bottom firmly in the earth. A standard 20-rod roll of fencing will provide about 66 racks. They may be stored and used from year to year.—H. B. Agnor, Lexington, Va.



Windmills Scare Away Rabbits

GARDEN plants frequently suffer from rabbit intruders. You can frighten them away by setting up toy windmills among the plants. Make the windmills from tin-can stock in the shape of flowers and paint them bright colors. These are both effective and attractive.—Margaret M. Bailey, Quincy, Ill



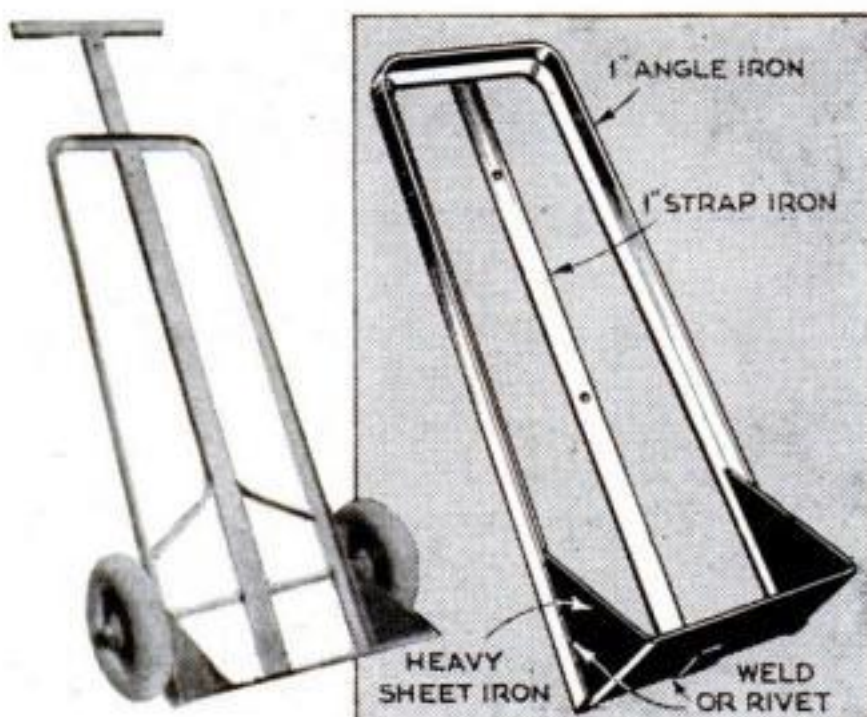
Can Supports Bags for Filling

IF YOU are looking for a way of holding cloth or burlap bags while they're being filled, an old ash can will do the trick nicely. Just solder three or four nails around the lip of the can and hook the edges of the bag over these. It may help to file the nails sharp.—Victor H. Lamoy, Upper Jay, N. Y.

Iron Frame Turns Discarded Lawn Mower into Dolly

A LAWN MOWER doesn't have to cut grass to be useful. Even one that has seen better days can do a good job of transporting heavy or bulky items. Simply remove the cutter-bar assembly and bolt on an iron frame such as that shown at the right.

Though welded construction is shown, either rivets or nuts and bolts can be used to hold the pieces of angle, strap, and sheet iron together. The angle iron makes the frame strong and rigid without being too heavy.—John Krill, No. Lima, Ohio.



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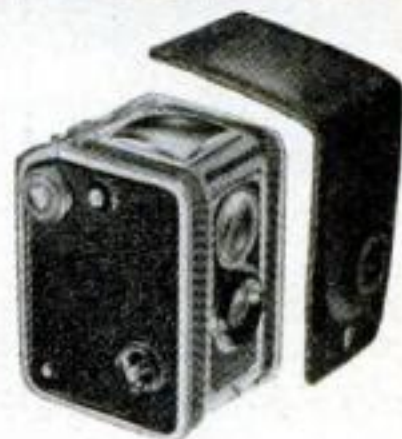
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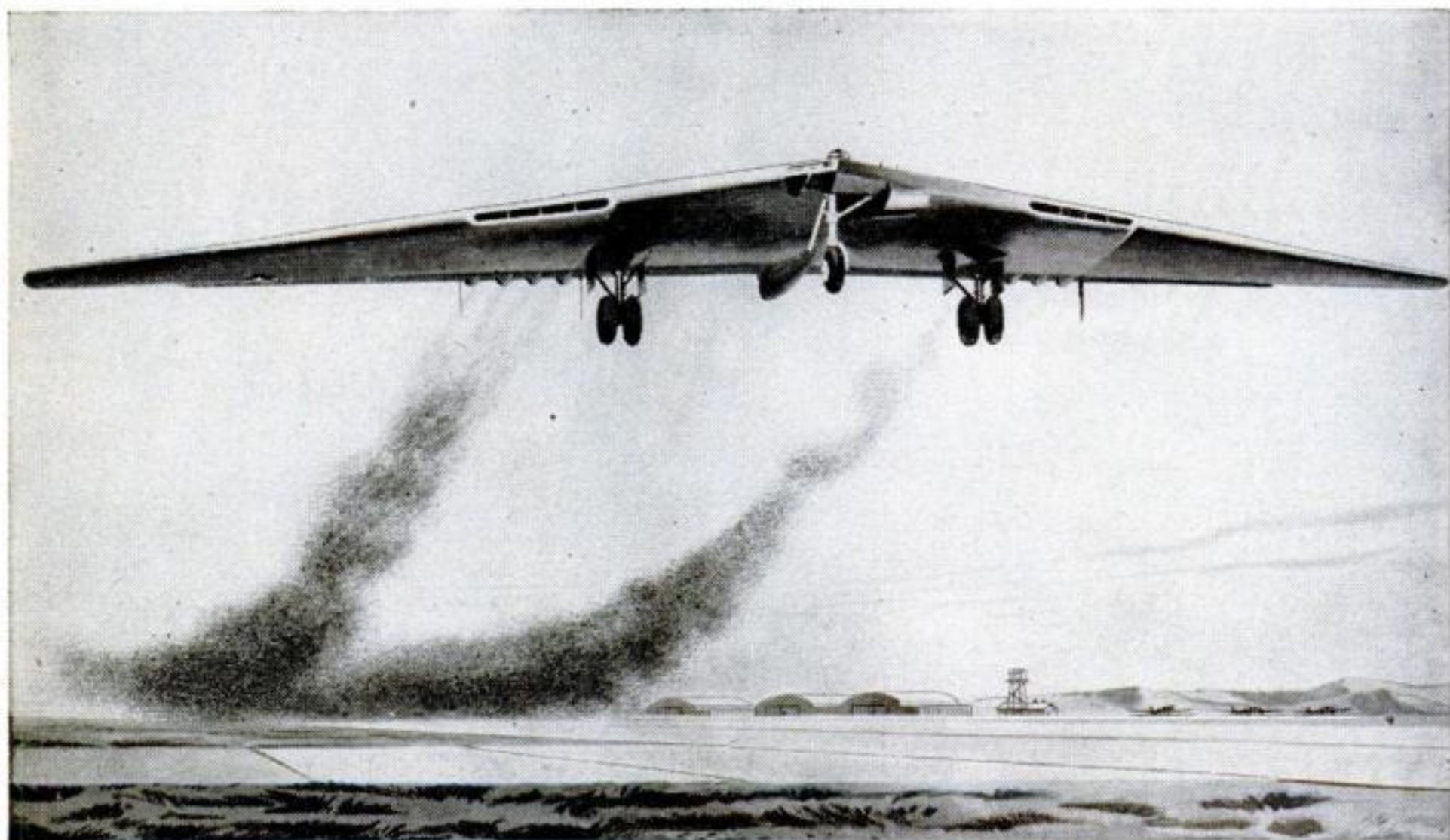
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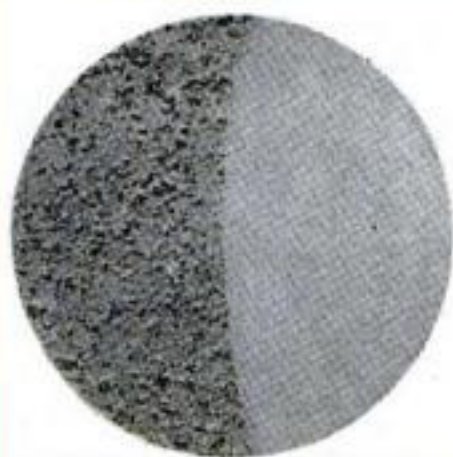
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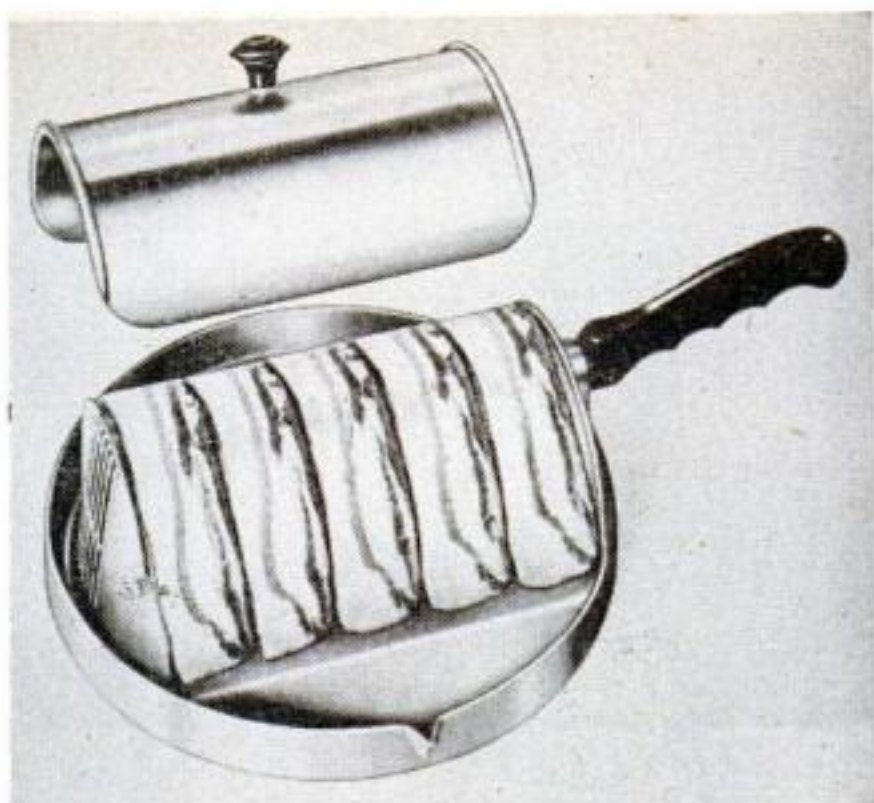


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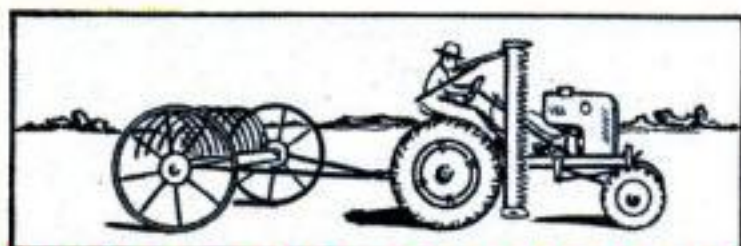
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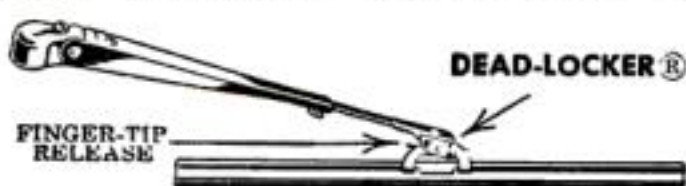
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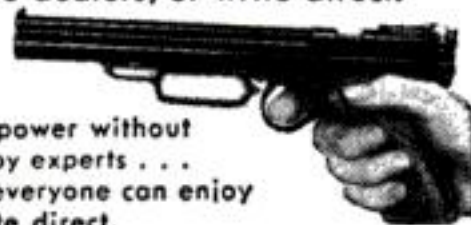
Crosman *Silent* RIFLE



. . . is available in single-shot or magazine types, .177 or .22 cal. A man's size, fine quality gun, with perfect balance, rifled barrel, rear peep and blade front sights. At sporting goods or hardware dealers, or write direct.

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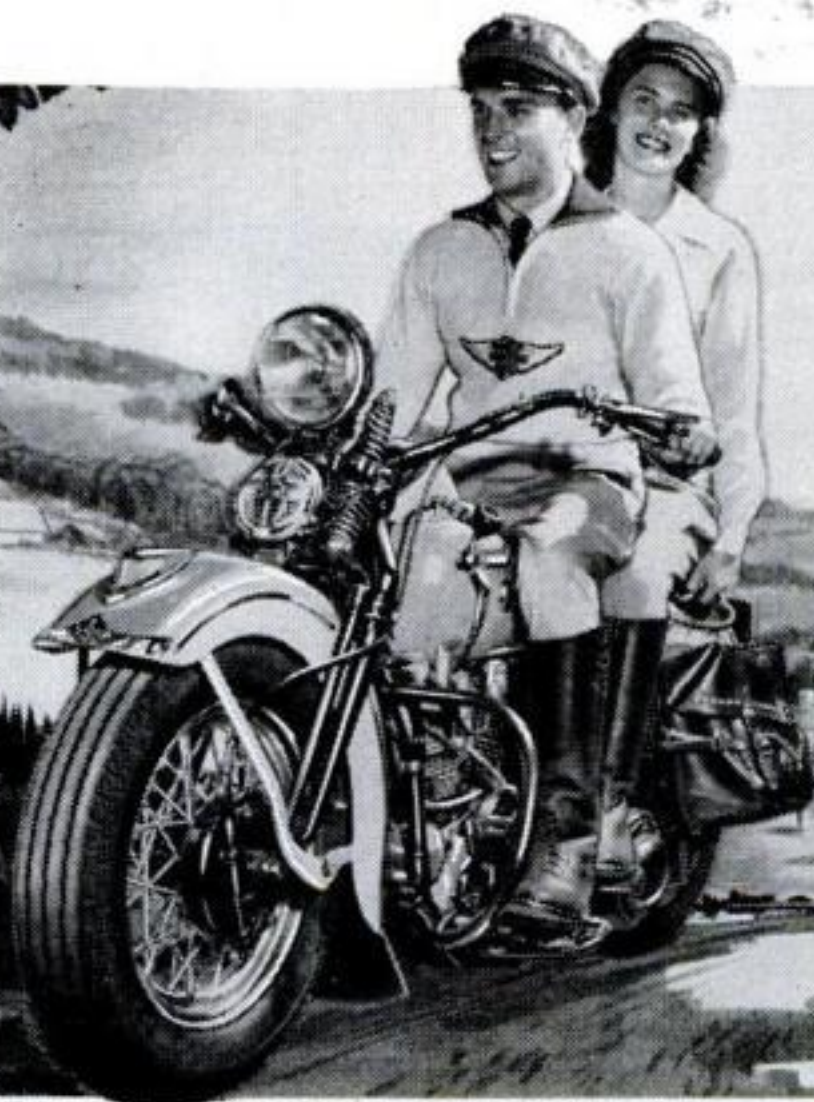
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Like to roam? Does a winding road fascinate you with its alluring promise of something new around every bend? Do you enjoy country air, the fragrance of fields, meadows, woodlands? Do tumbling waterfalls, quiet lakes, broad rivers bring you back to them again and again? Then you'll like motorcycling, world's greatest sport! For it takes you places, out in the open, to scenic wonderlands, faraway cities, brings you the thrills of gypsy tours, race meets, hillclimbs, exciting vacations . . . makes every spare hour mean happier, healthier outdoor enjoyment. It's so easy to enjoy motorcycling, easier than you think to own a genuine Harley-Davidson. Why not get started now? See your dealer. Mail coupon today.



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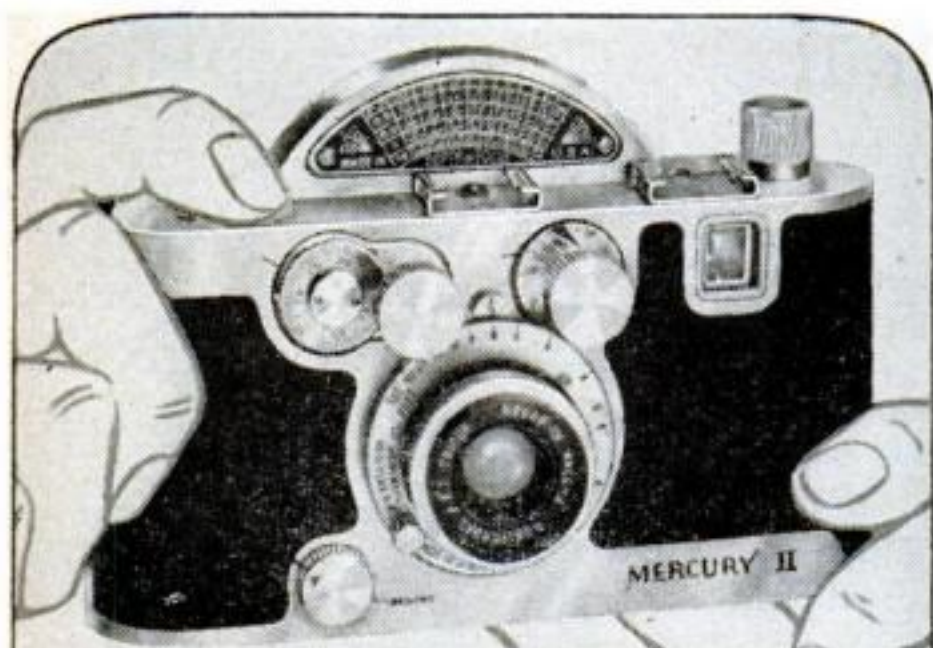
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Coated f2.7 lens....82.90

THE best color shots I've ever seen." . . . "Nothing can touch it for color . . . even the background is crisp and sharp." . . . "The best color camera, American or foreign, that I've used, regardless of price."

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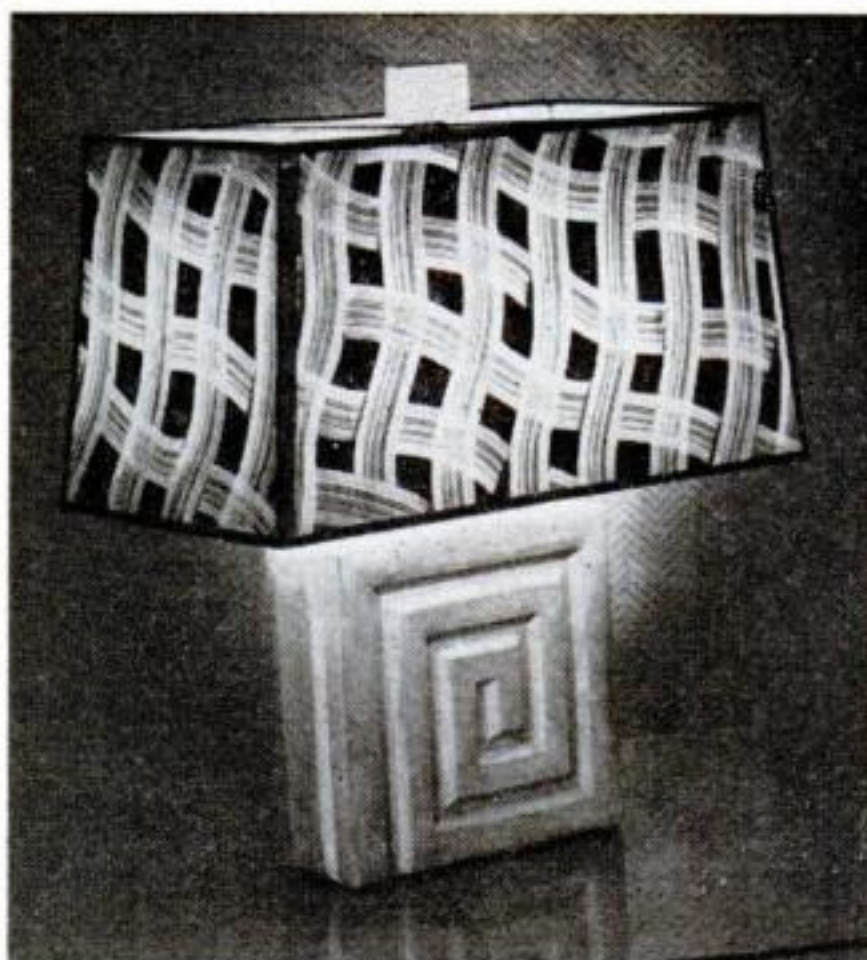


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A LAMPSHADE of durable Lumarith plastic not only gives more uniform diffusion of light, but its smoother surface makes it an appropriate "canvas" for a hand painting. The design on the lampshade above, produced by Lamp Fair, of New York City, gives the illusion of a third dimension when the lamp is lighted.



Projects Brighter Pix

SHARP screen images are possible without shutting out all the light in a room when the new Kodaslide Projector is used. Built for projecting 2- by 2-inch slides and transparencies, this Master Model has a 1,000-watt lamp and extremely fast lenses—coated with a microscopically thin layer of magnesium fluoride—that increase the amount of light delivered to the screen. The projector is made by the Eastman Kodak Co., of Rochester, N. Y.

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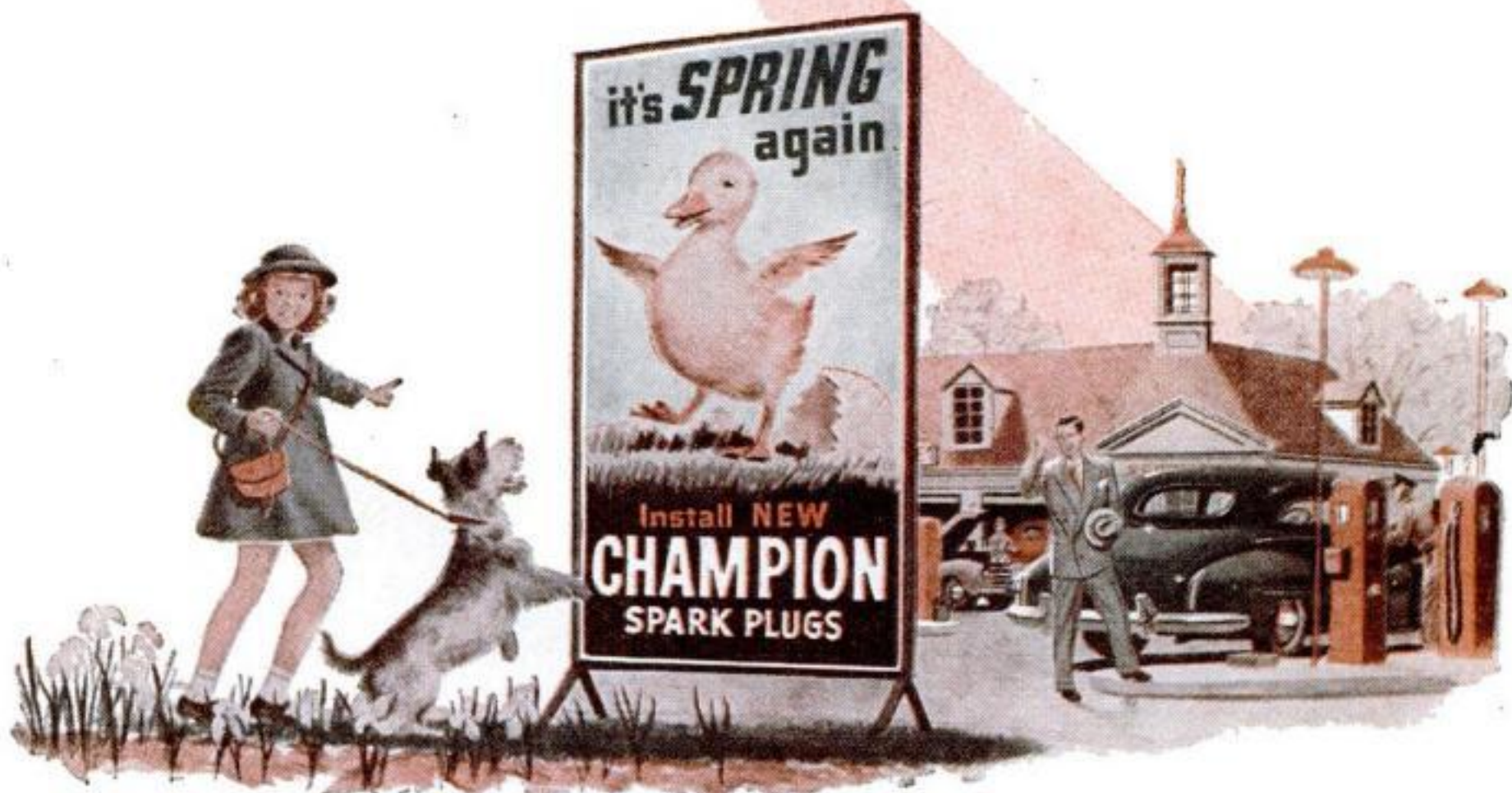
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MAY 1948 249

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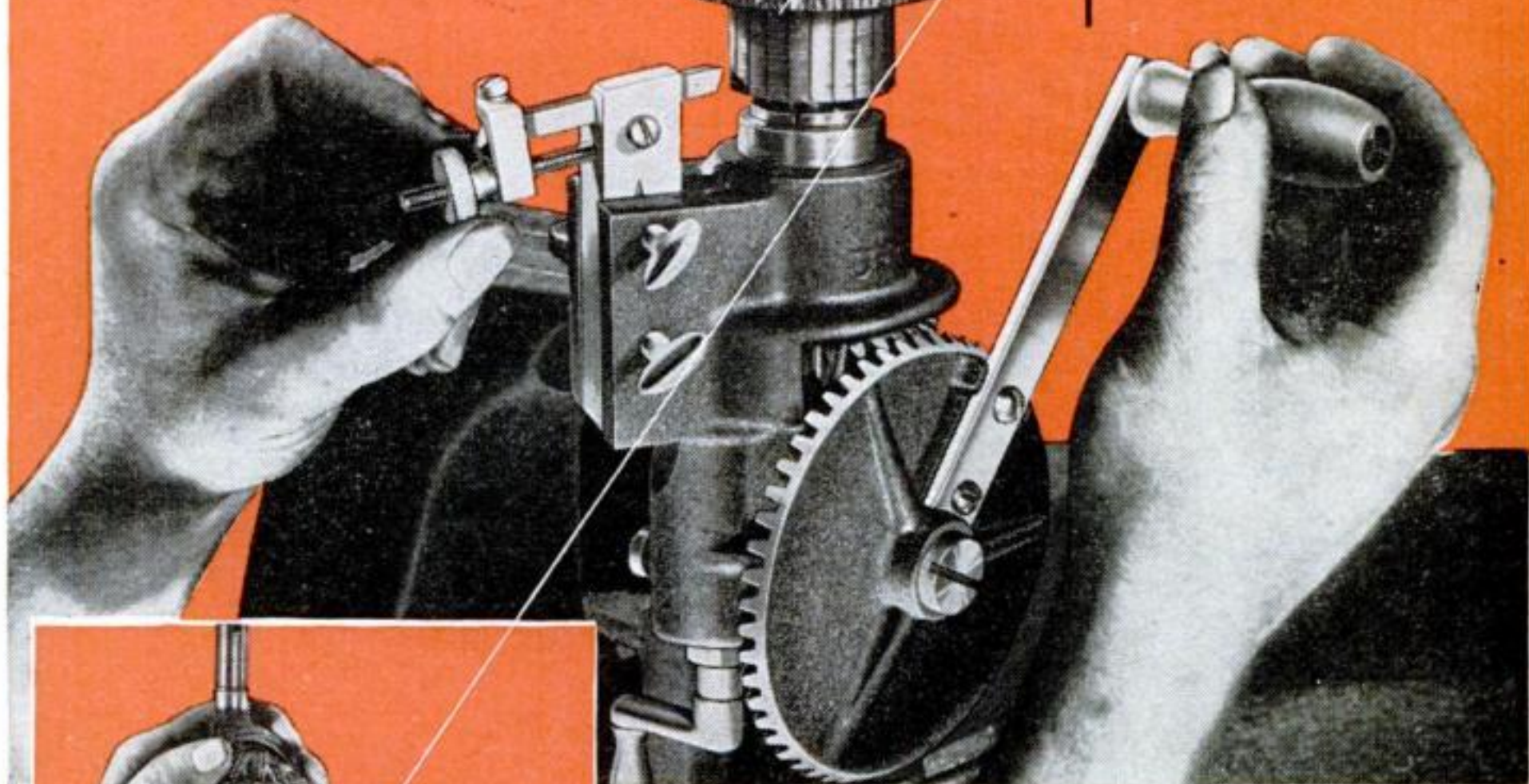
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MAY 1948 251



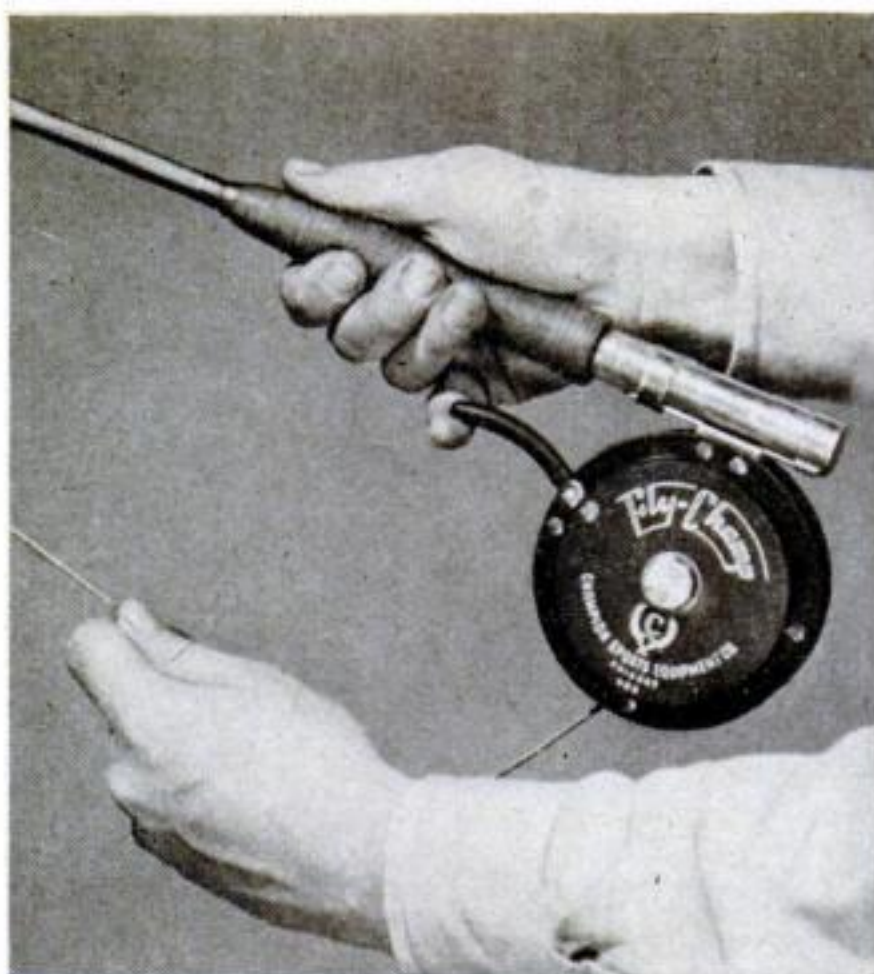
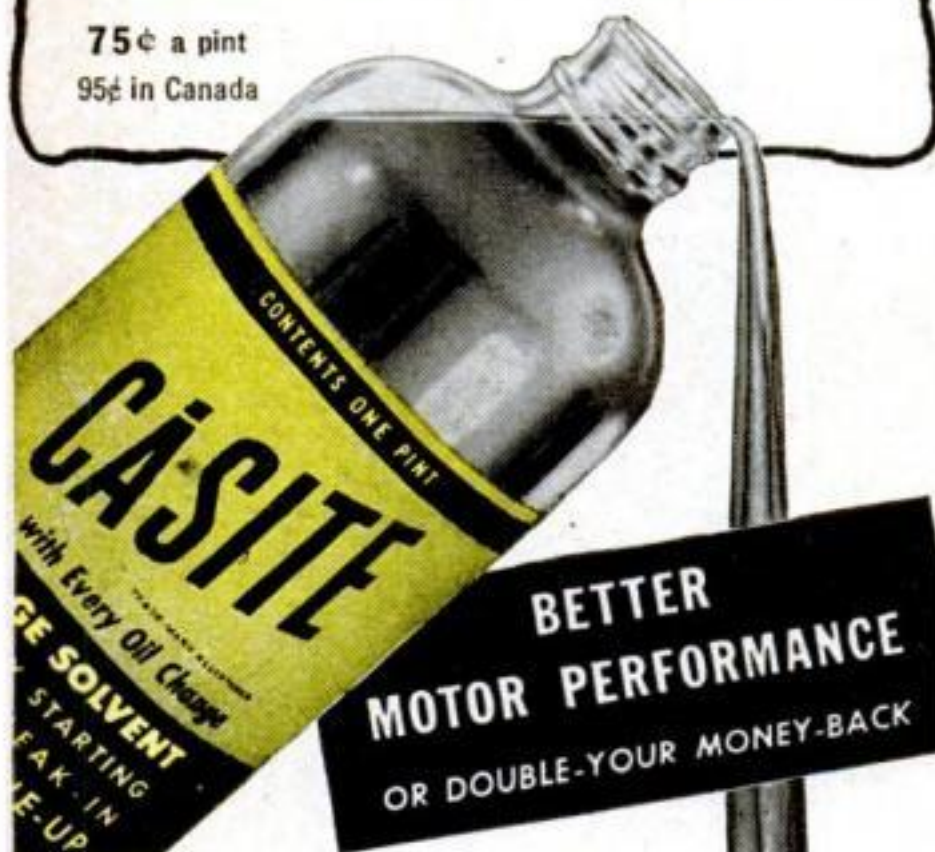
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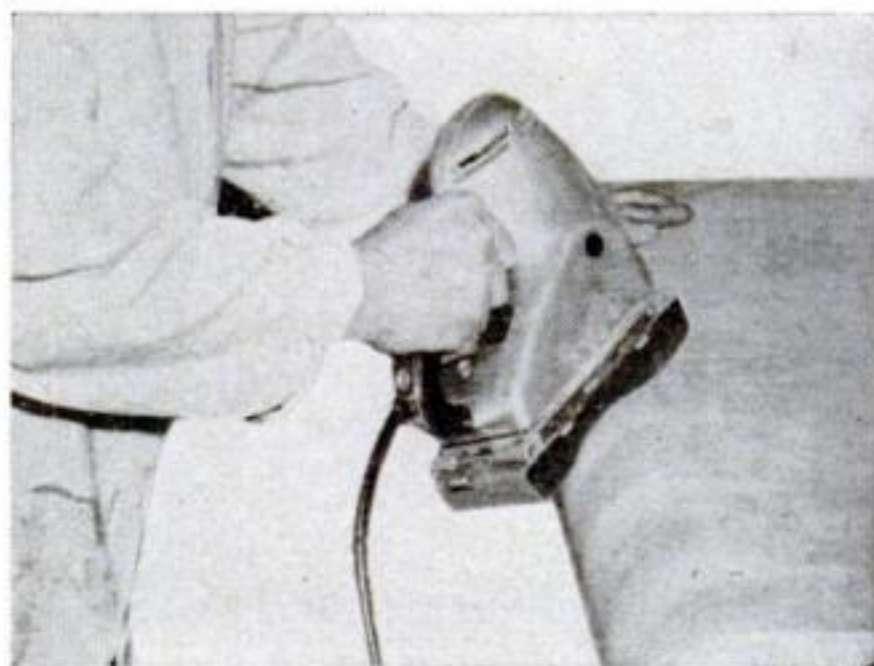
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HERE'S a reel for fly fishing that will please anglers who want either automatic or manual right-hand line take-up. The finger-operated trigger shown above controls the automatic take-up and folds back when manual operation is desired. If a change in line is needed, an auxiliary spool can be inserted in the reel in place of the one being used. The Champion Sports Equipment Co., of Chicago, makes the reel.



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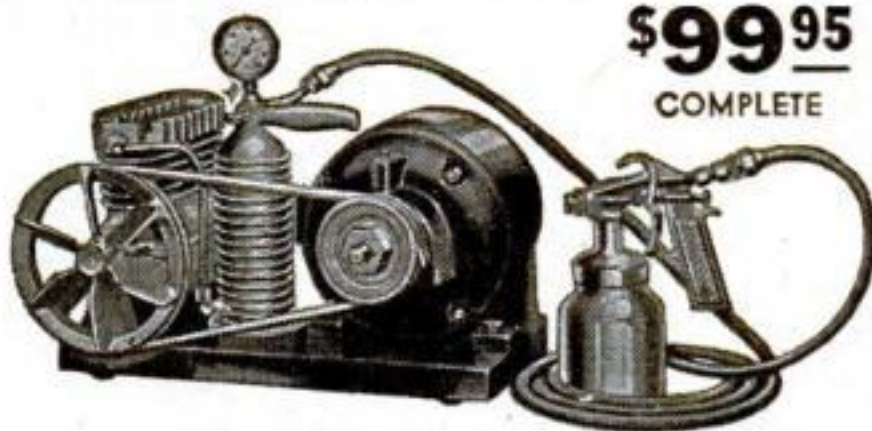
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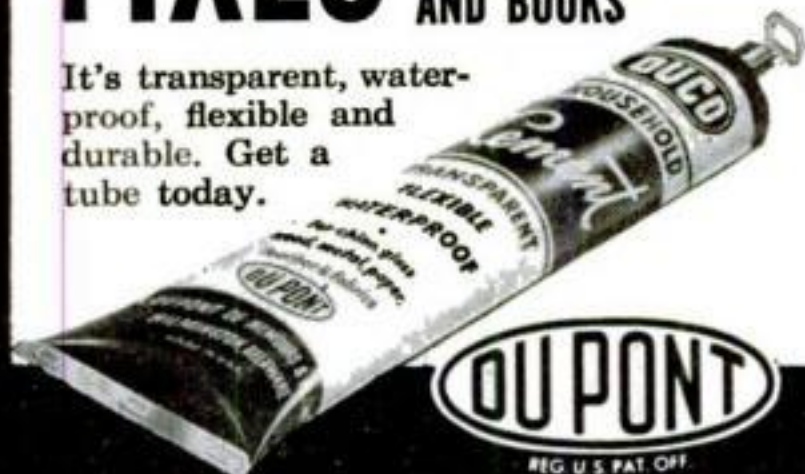
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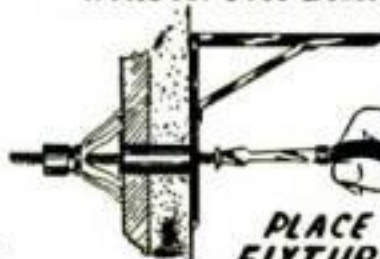
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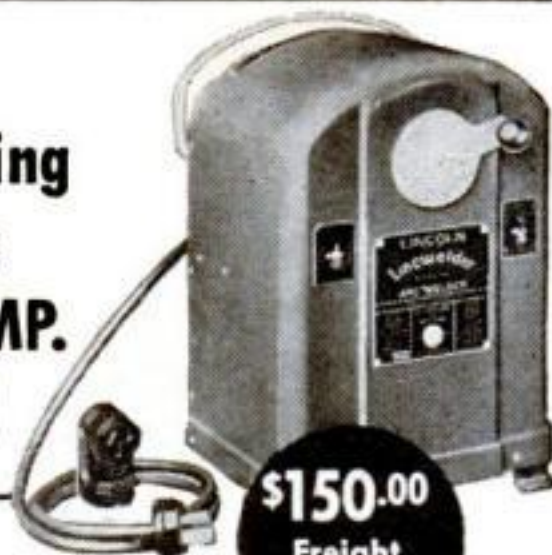
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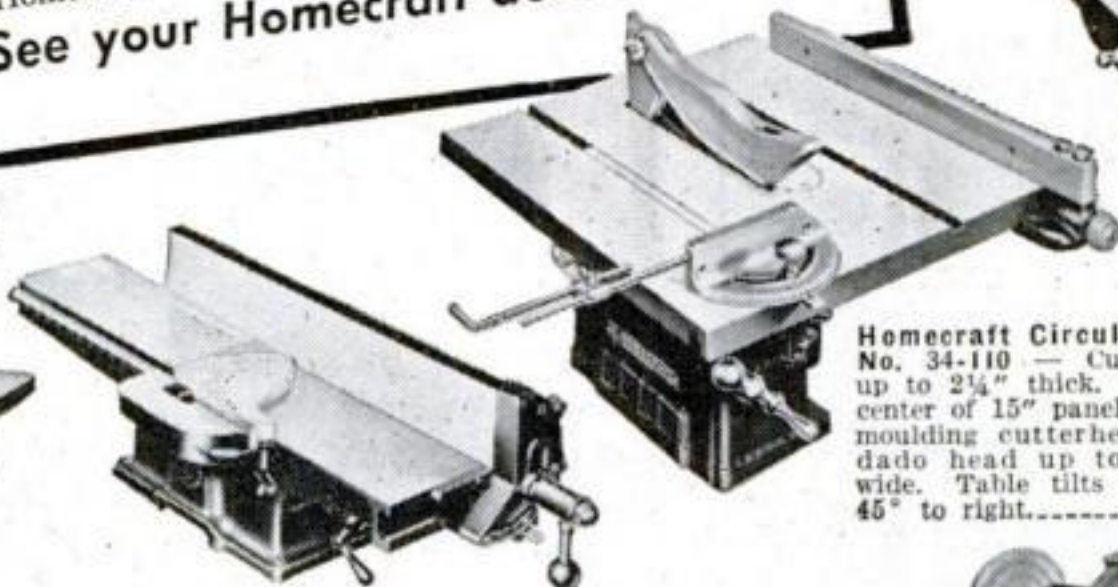
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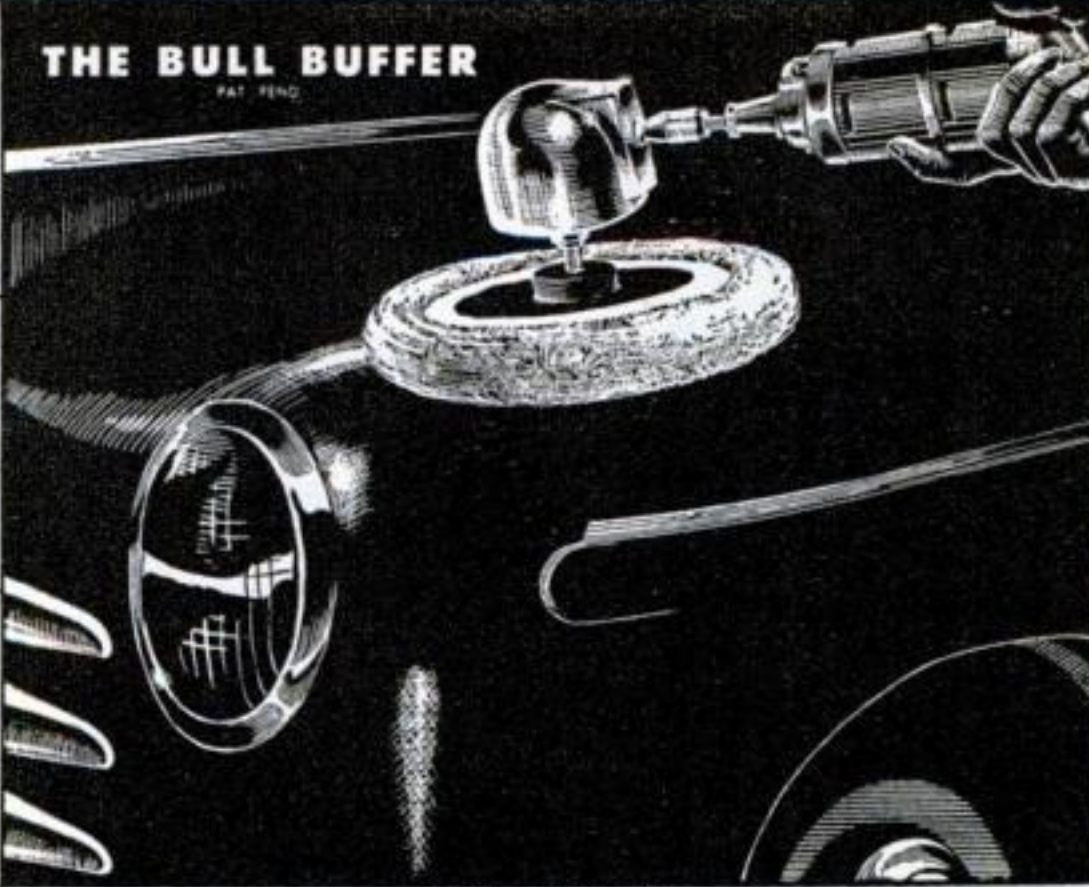
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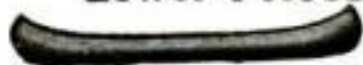
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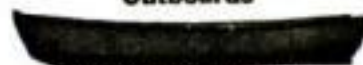
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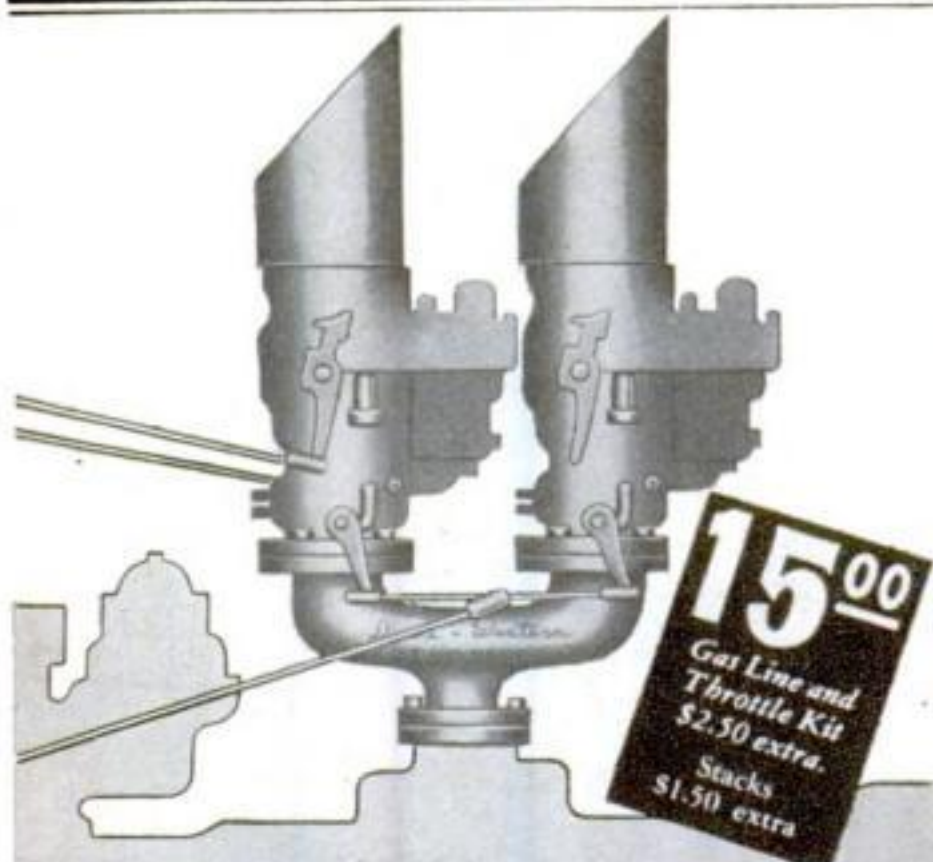
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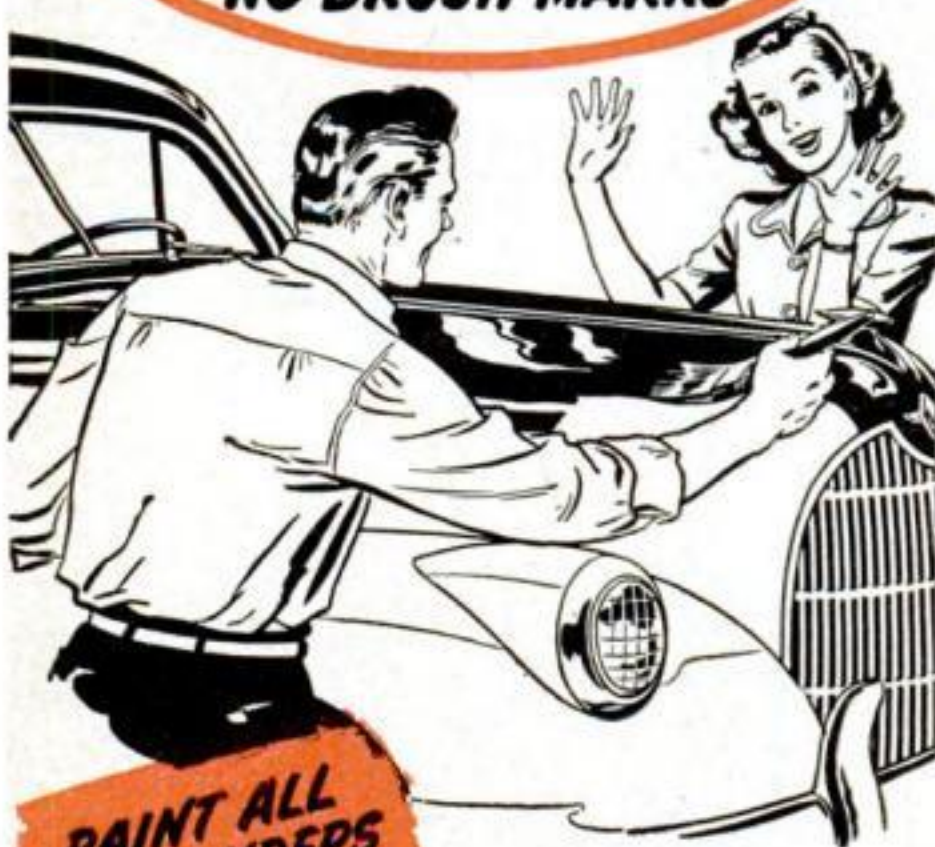
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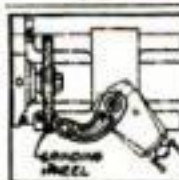
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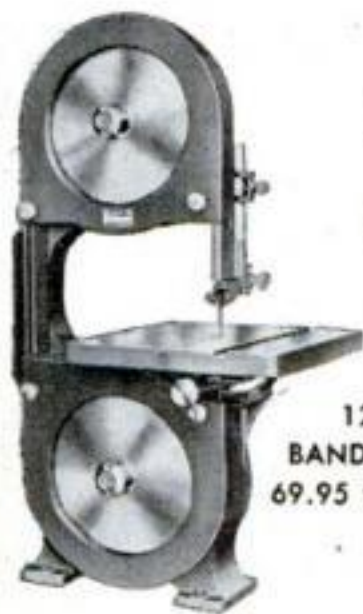
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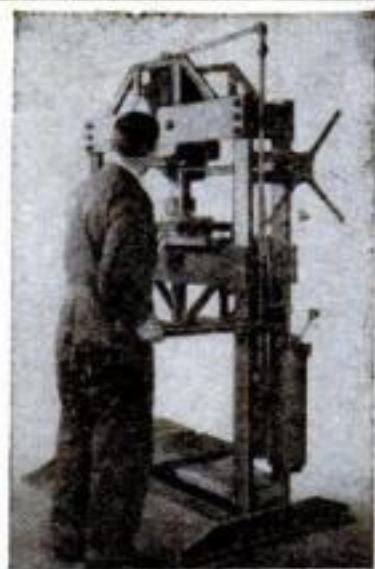
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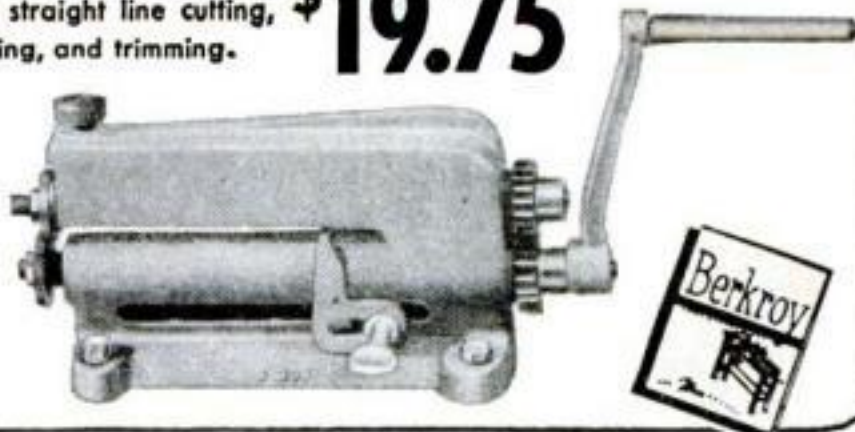
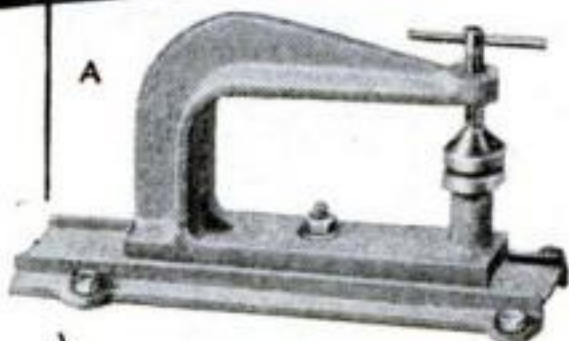
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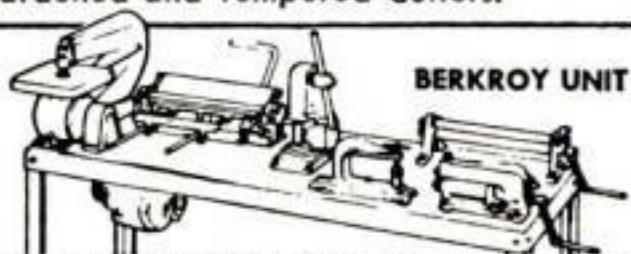
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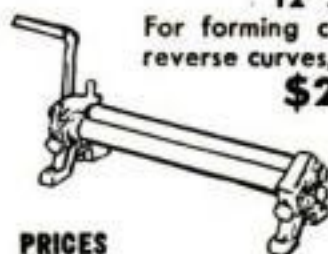


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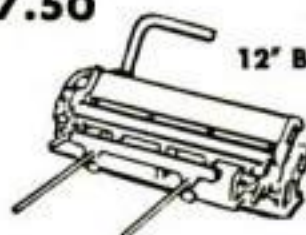
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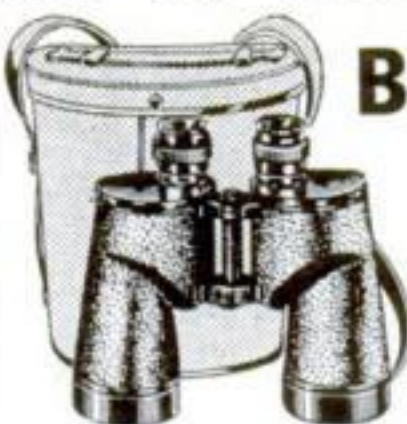
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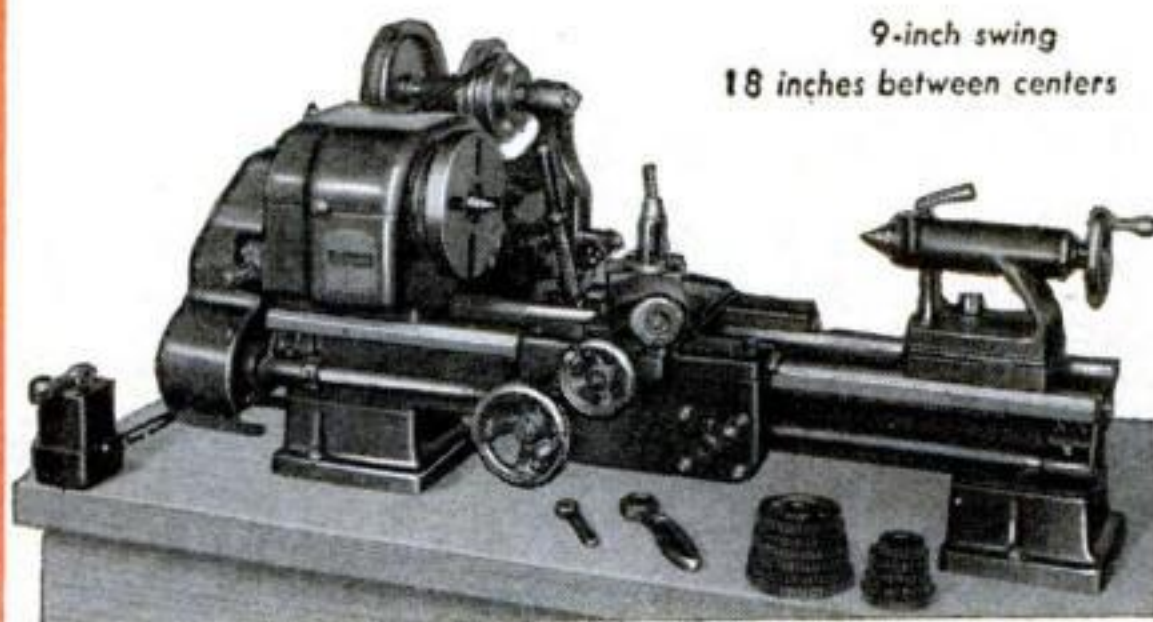


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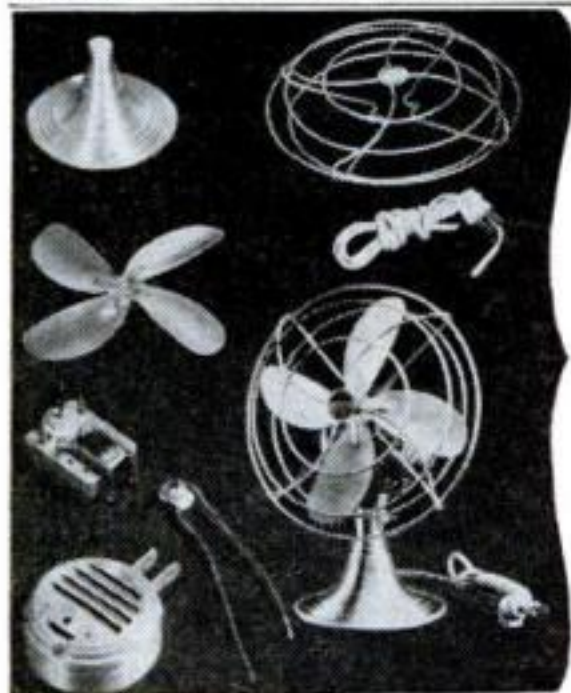
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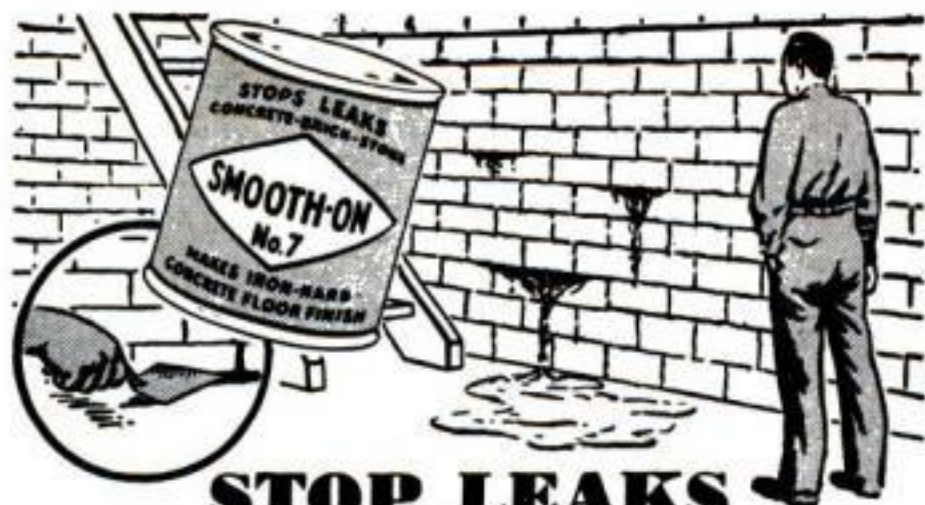
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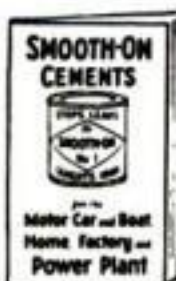
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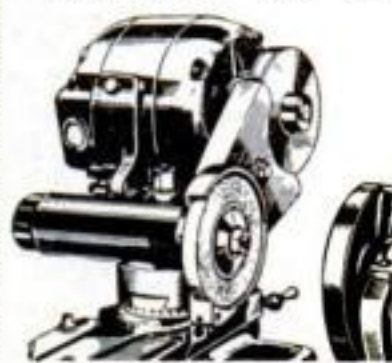
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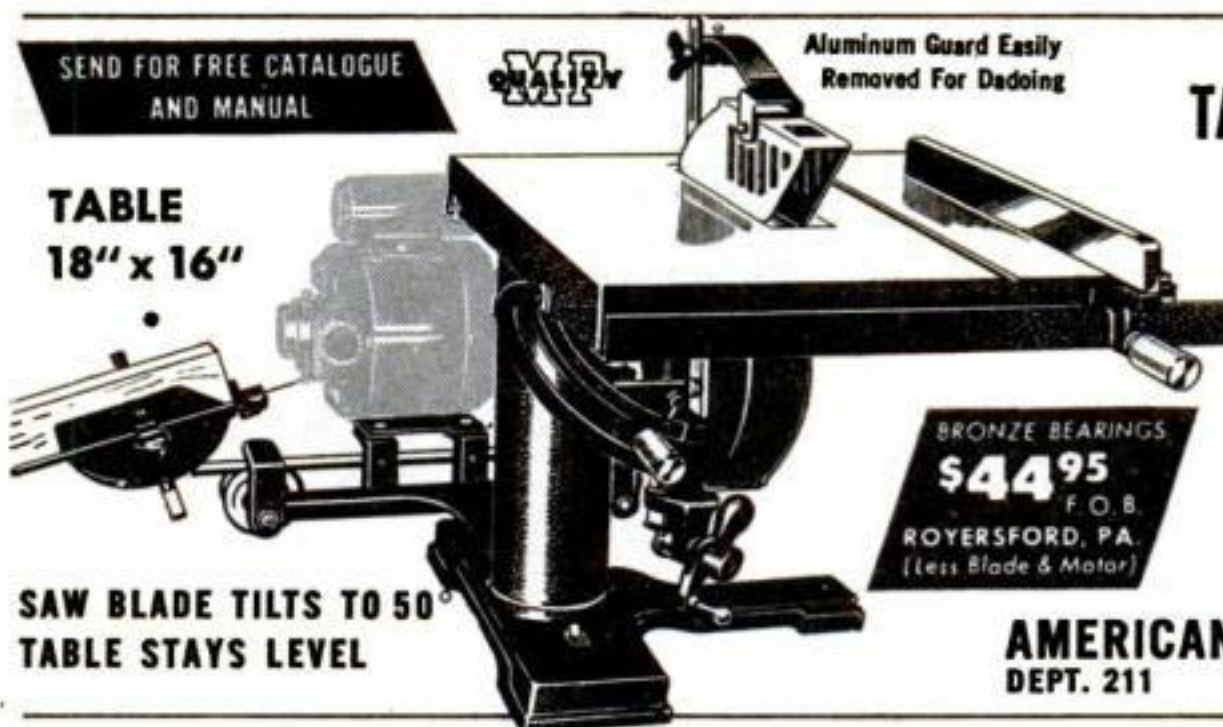
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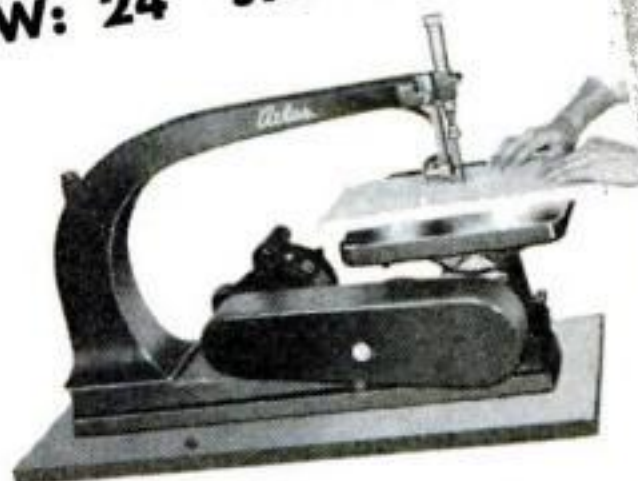
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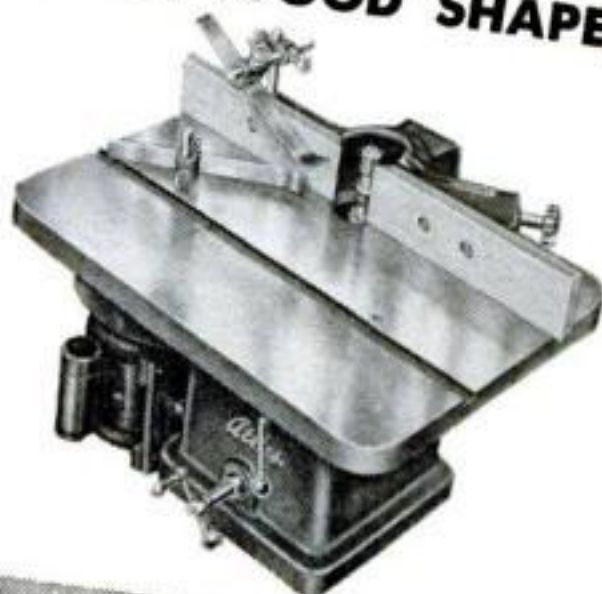


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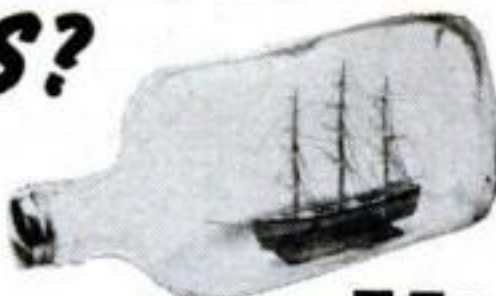


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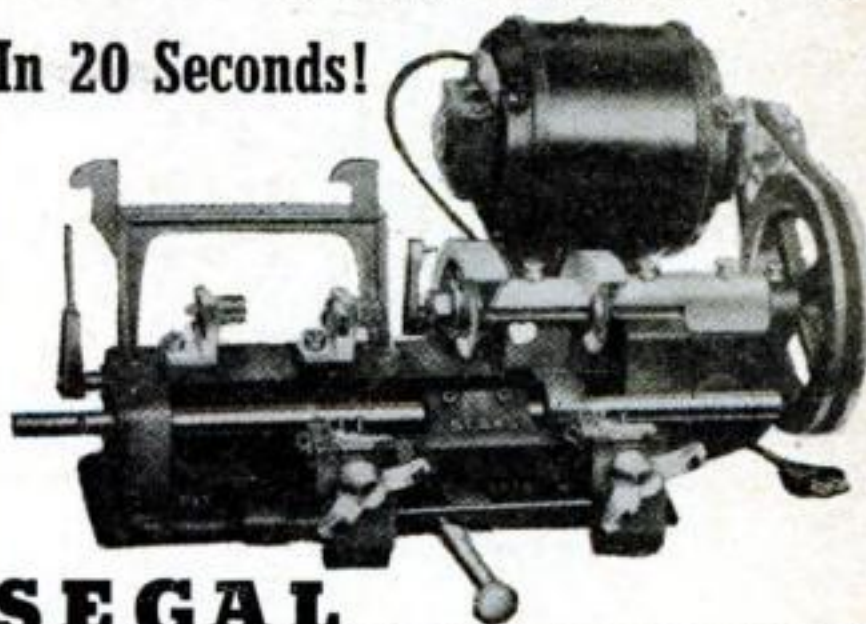
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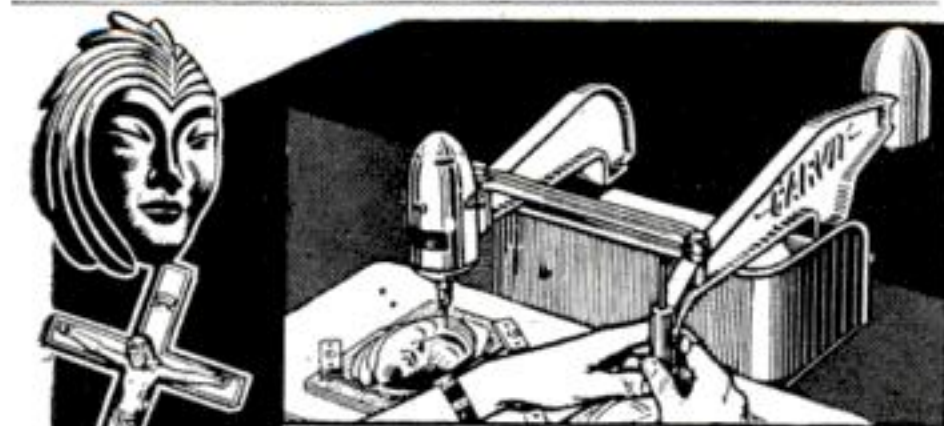
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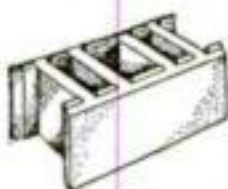
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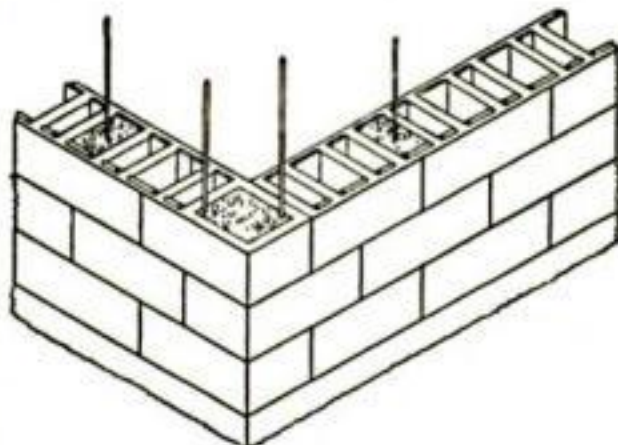
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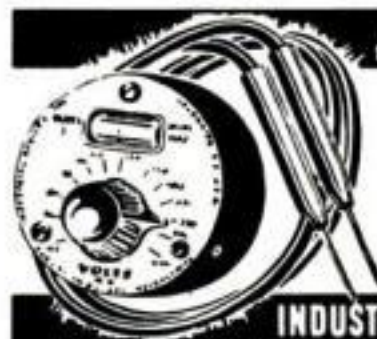
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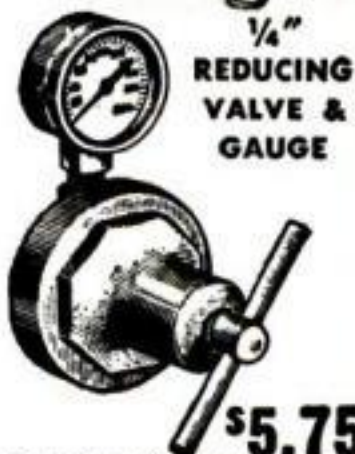
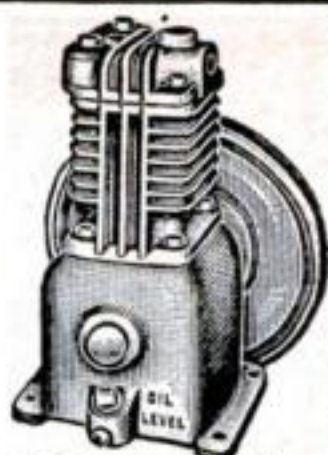
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BELSAW Multi-Duty Planer



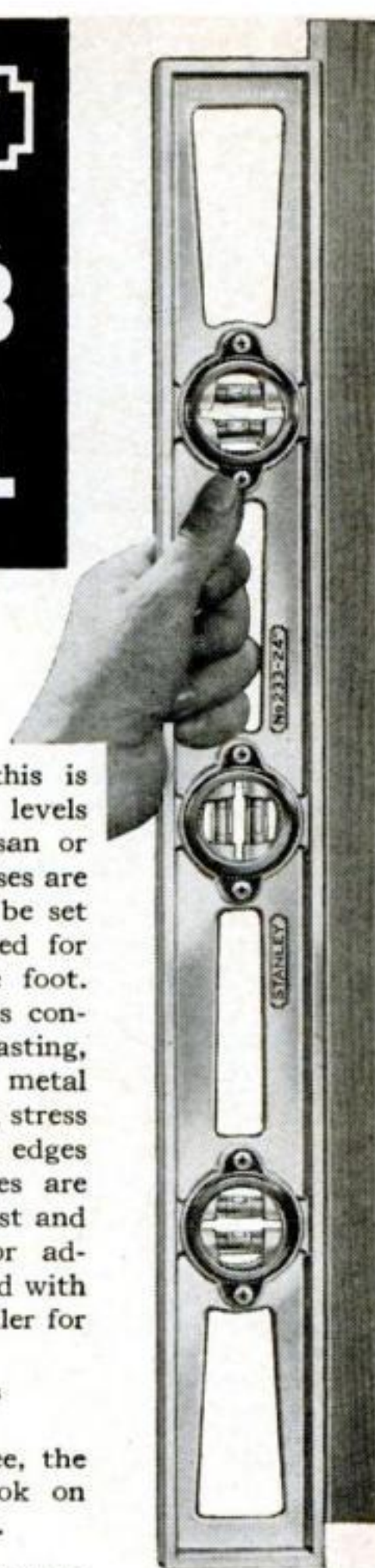
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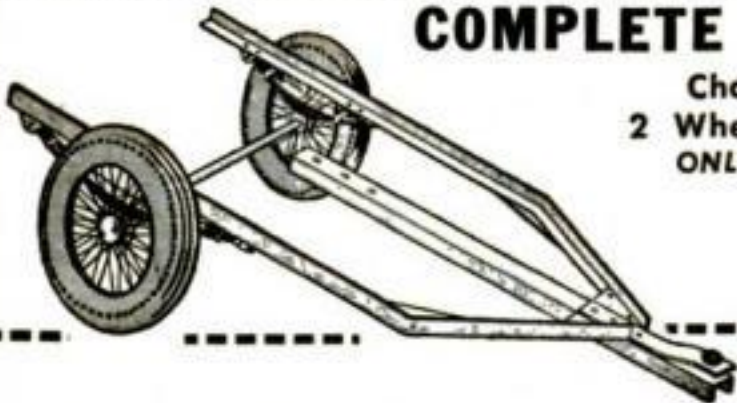
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For every purpose at 15% of Value.

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Positive displacement gear type.
Capacity: 1 gal. per min. at 1500 R. P. M. at 1500 P. S. I.
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solenoids for reverse and forward motor control. 2 solenoids throw clutch to engage drive. With brake assembly. Can be used as boat rudder control, converted for lathe tapping and slow speed motor tool. Wt. 29 lbs. Finest precision workmanship.

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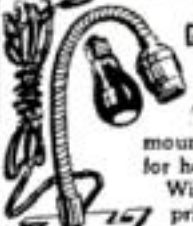
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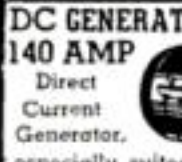
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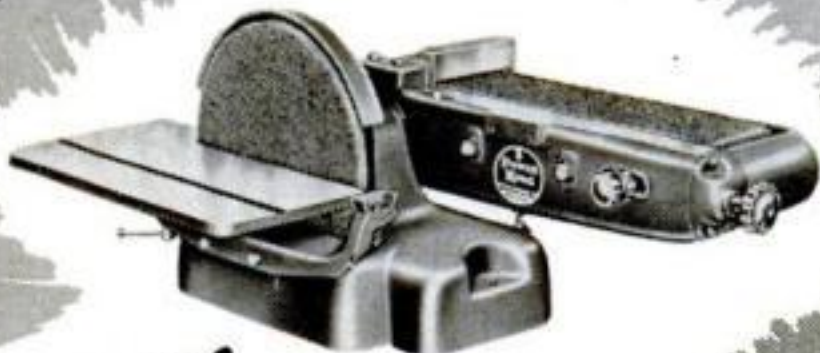
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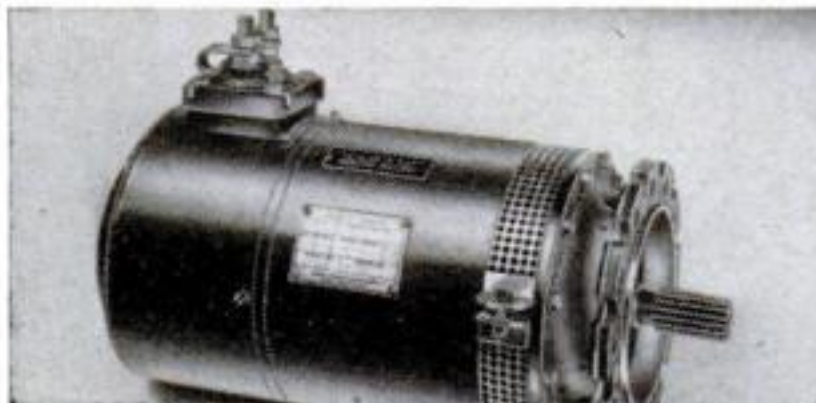
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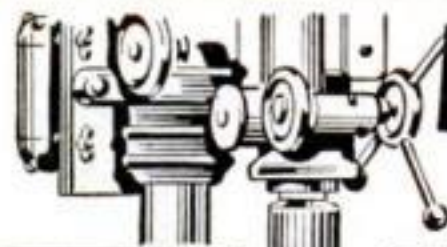
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TO: *Reader*
FROM: *Editor*



Mike Lubin, Staten Island high-school senior, shows the seismograph that helped him place in finals of national scholarship contest. Mike used plans first published 13 years back, in November 1935 issue of **POPULAR SCIENCE** (inset above).

A Good Idea Never Dies

PS ARTICLES seem to live on forever. By now we're accustomed to requests for reprints of stories that appeared 10 or even 20 and 50 years ago. But it was a pleasant surprise to discover that plans published in **POPULAR SCIENCE** way back in 1935 helped a young high-school senior place in the finals of the Westinghouse Science Talent Search.

Michael Lubin, of Staten Island, N. Y., was barely old enough to be trusted with a screwdriver when Roy H. Baldridge's article on a homemade seismograph appeared in this magazine. He came across it while seeking a suitable project for the scholarship contest, and as the illustrations show, closely followed the 13-year-old **PS** plans. Mike made practically every part of the earthquake-measuring instrument in the basement shop he shares with his kid brother and his father, an accomplished craftsman.

The seismograph is now set up in a cramped storage room adjoining the Lubin cellar. It consists of a pendulum (a lead-

filled tin can hung on fine wire) supported by a steel bar sunk in concrete. When earthquake tremors shake the concrete and steel support, the heavy pendulum bob moves less than the support rod because of the bob's inertia. This difference in movement is magnified by a long arm that makes wiggly lines on the smoked paper of a recording drum. The recording drum is simply an orange-juice can rotated on a geared shaft by an instrument motor. Mike's seismograph, while no rival of expensive laboratory instruments, is so sensitive that it has picked up an earthquake in Fairbanks, Alaska—3,300 miles away.

POPULAR SCIENCE shares Mike Lubin's pride in his achievement. And while he works hard at becoming a physicist, we'll work hard at more articles that live on forever—whether they win prizes or just serve as handy reference to keep around in case something goes wrong with the plumbing.

Martin M. M.

This One



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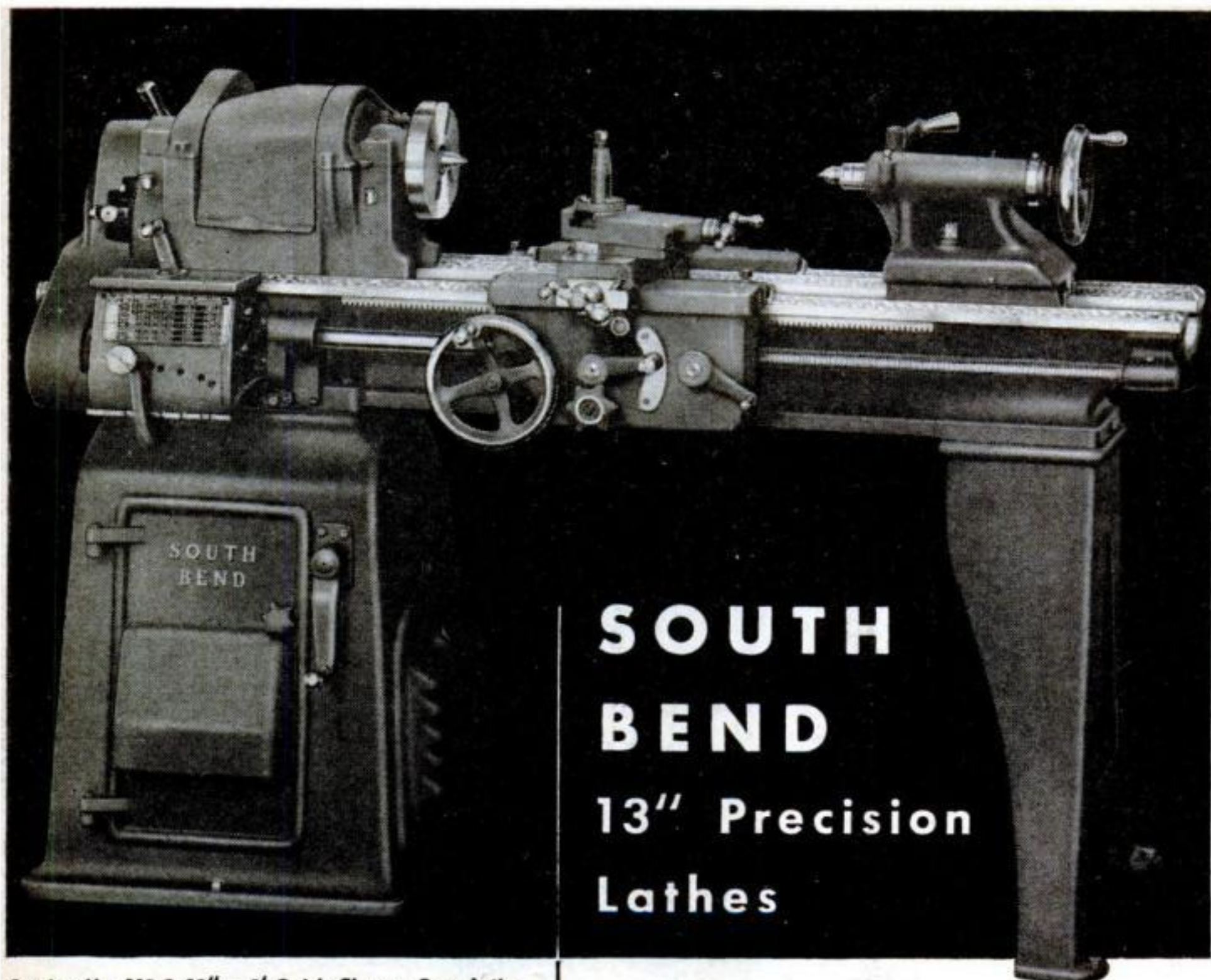
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SPINDLE BORE 1 inch
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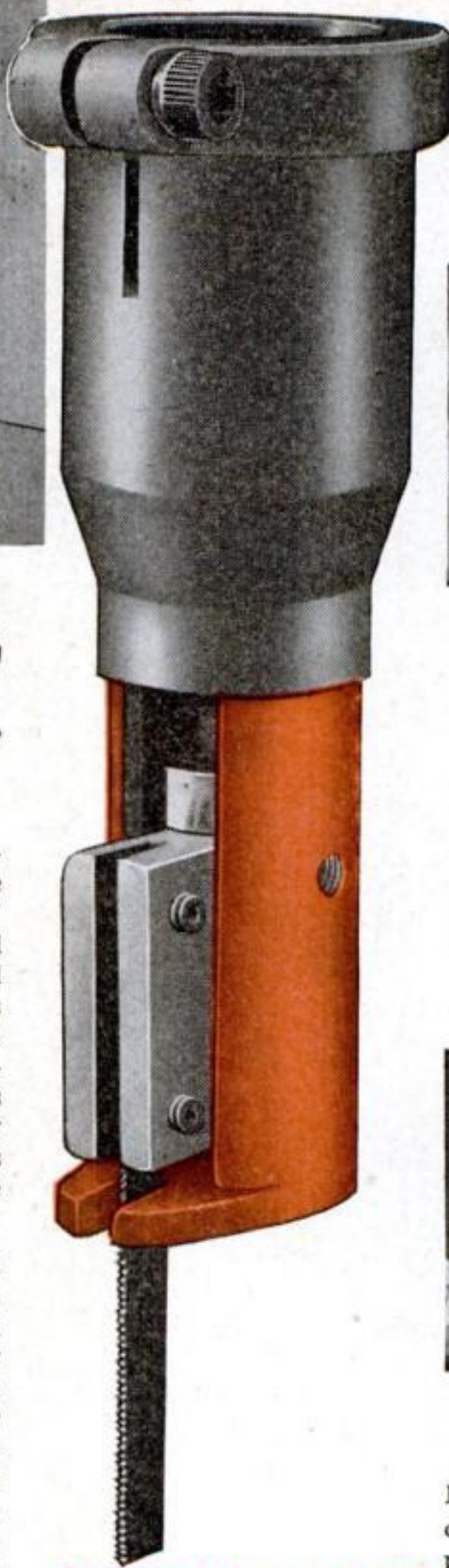
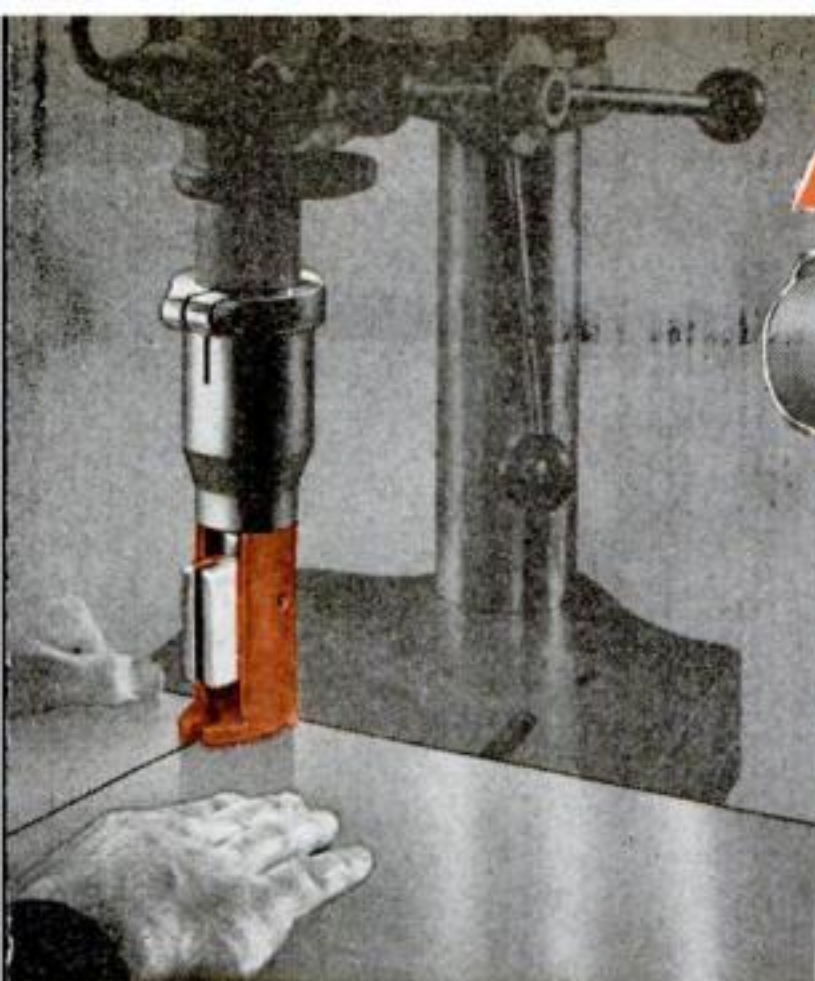


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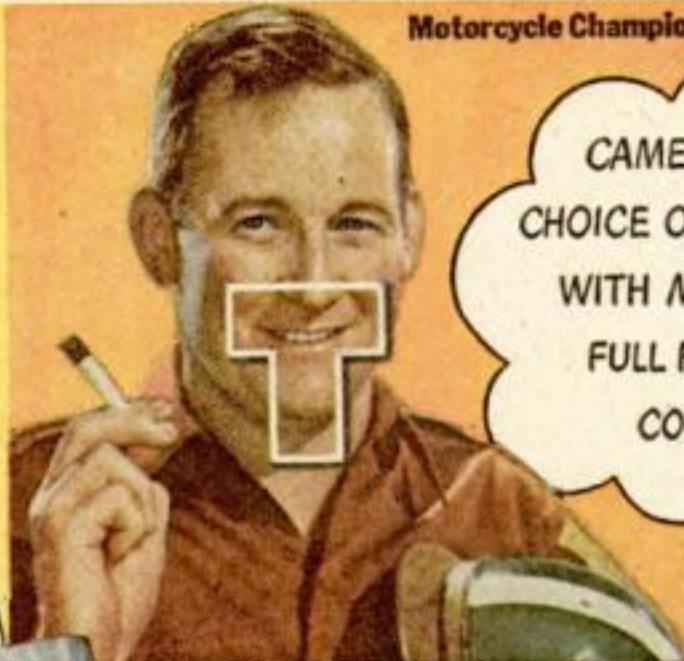
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